MOBILE APPLICATION FOR DETECTING THE ADULTERANTS OF MILK FOR PUBLIC HEALTH AWARENESS

Mrs. Rajeshwari. R*

Agila.S, Nivethitha.P, Subashini.I, Uma Maheshwari.J**

Abstract—

Milk is a habitual, health drink consumed by people of all countries. A large population in our country depends on milk from regional suppliers. Due to the high nutrient value and water content, milk serves as a fine medium for microbial growth. This demands high standards of hygiene in the production and distribution of dairy products such as milk. Due to this increasing demand, adulteration of milk by various substances has been very common in our country. The major adulterants added are urea, detergents and starch which are detrimental to human health. Therefore it is essential that household consumers test milk for the presence of these adulterants before consumption. In this work an attempt is made to test the adulterants by optical method involving IR light that does not affect the sample. Spectrophotometric analysis was done for adulterated and unadulterated samples and the absorbance was studied. Easy and friendly monitoring technology with a mobile application was created. This enables instant detection of milk safety for consumption thus bringing public health awareness.

***Keywords*— Milk adulteration, IR sensing, App.**

* Assistant Professor, Department of Biomedical Engineering, Sri Ramakrishna Engineering College, Coimbatore, India,

** Project students, Department of Biomedical Engineering Sri Ramakrishna Engineering College, Coimbatore, India,

I. INTRODUCTION

Milk is an important source of nutrient required for growth and maintenance of health in children and in adults. Proteins, carbohydrates, vitamins, fat and minerals are present in abundance in this drink. Milk is one of the products which can be adulterated in many ways affecting the quality of further dairy products. Extension of milk with low value ingredients known as 'economic adulteration' is often been in practice. A huge number of laboratory tests are being conducted for screening and approving the quality of milk supplied in the markets. The most widely used methods for milk analysis are UV- photometry, the Biuret, and other classical tests. Commercialized ready-to-use kits are available in markets that detect adulteration in milk. These procedures can detect the presence of urea, fertilizers, starch and detergents. However, most of these methods are tedious owing to the large number of analytical steps. This results in time-consuming analysis, reagents availability, expensive equipment which could involve very high operating costs and maintenance. Hence to bridge the gap between laboratories and households, this technique is aimed at developing a mobile application that effectively detects adulteration by using mid-IR sensing.

II. MILK SAFETY IN INDIA

Food Safety and Standards Authority of India (FSSAI) show that more than 75% of milk contains urea, water, detergent, and starch. The National Survey taken on Milk Adulteration in 2011shows Five states were have 100 % non-conforming to the milk standards set by the FSSAI; 14 % of the milk from regional suppliers had detergent in them. Also 70% of milk samples from Delhi failed to meet the FSSAI standards. It was found that 46% of the milk was found to be diluted with water. In the survey taken by FSSAI, out of 1791 samples, urea was present in nearly 548 samples and 477 samples contained starch.

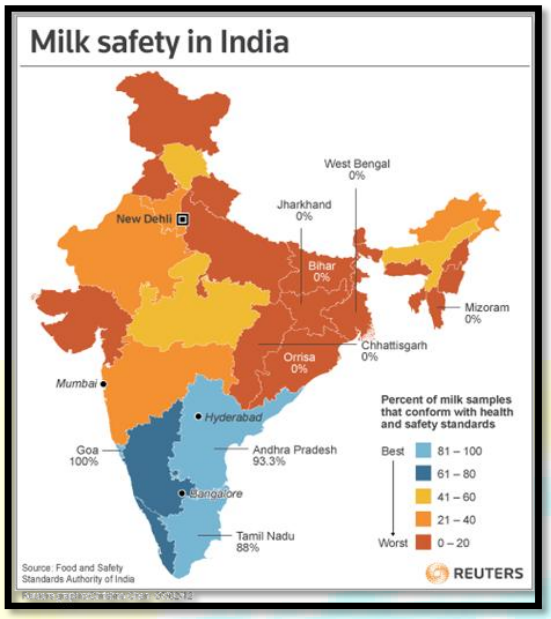

Figure 1: Milk safety chart (Food and Safety Standards Authority of India).

These adulterants are hazardous and cause irreversible damage to the body. The detergents in milk due to its high alkaline levels can cause food poisoning, gastrointestinal complications, tissue damages and protein de-naturation. Among the other synthetic compounds, urea is said to cause impairments, heart problems, cancer and even death.

III. ADULTERANTS AND THEIR HEALTH EFFECTS

The quality of milk is lost by adulteration by various synthetic components. Inclusion of such contaminants is principally to increase the shelf life. When consumers buy milk they are unaware of the presence of toxic substances added in it. Synthetic milk is prepared by mixing urea, starch, caustic soda, and common detergent or shampoo. Adulterated milk acts as a slow poison which does not kill at once, but gradually makes the body a potent ground for diseases. Deadly effects from consuming are likely to occur in pregnant women and patients suffering from heart ailments and high blood pressure. As infants and children constitute the primary consumers, even low levels of toxic substances can have serious effects. Detergent added to milk increase the foaming and gives it a thicker appearance. Addition of these chemicals will cause health problem especially related to stomach and kidneys. Other synthetic components can cause impairments, cancer or even death. While the immediate effect of drinking milk adulterated with urea is gastroenteritis, the long-term effects are far more serious. It can lead to vomiting, nausea and gastritis.

IV. METHOD IMPLEMENTED

A. *SPECTROMETRIC ANALYSIS*

In FTIR, interferometric modulation of radiation is used to measure multiple frequencies simultaneously. The resulting interferogram is converted to the original spectrum using complex algorithms. Infrared (IR) spectroscopy indicates typical vibration modes of covalent bonds in molecules, and thus contains quantitative information about all the constituents that absorb IR radiation, including proteins. FTIR spectroscopy is monotonously used by laboratories specializing in milk testing, because it is a fast, non-destructive, and easy procedure. It enables simultaneous measurement of several components in complex natural media Fresh milk samples from cow farm were used for analyzing the transmission and absorbance values. Unadulterated milk sample having 4.40 % water and 5.30% fat content was employed for the analysis. The spectrophotometer used was ALPHA, Bruker German makes. The instrument has a spectral range of 600 – 4000 cm^{-1} and a wave number accuracy of less than 0.05 cm^{-1}. The transmittance and absorbance values were analyzed for selecting the range of IR-LEDs and photodiodes used for this technique.

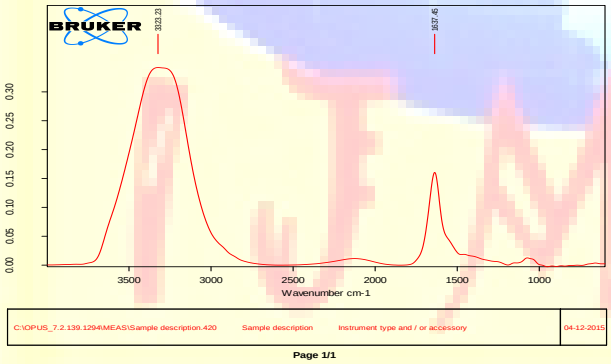

Figure 3: Absorbance spectrum of fresh milk.

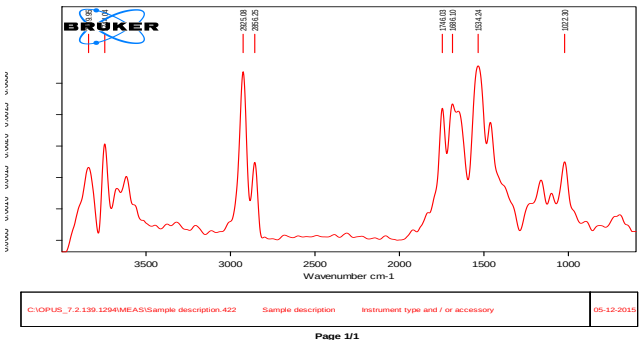

Figure 4: Absorbance spectrum of urea

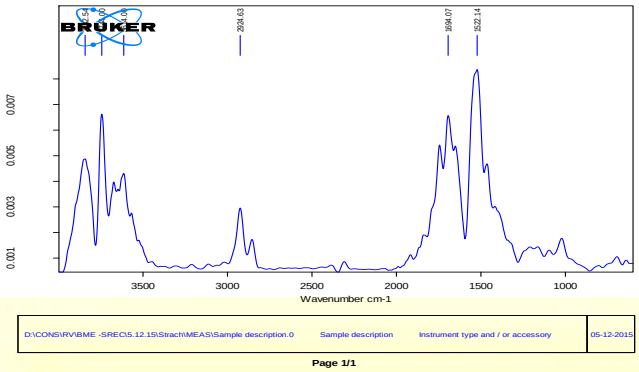

Figure 5: Absorbance spectrum of detergent

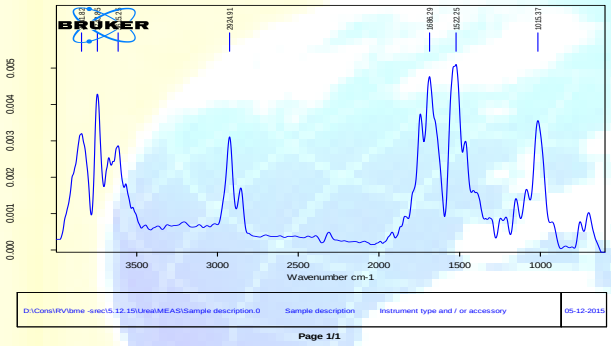

Figure 6: Absorbance spectrum of starch

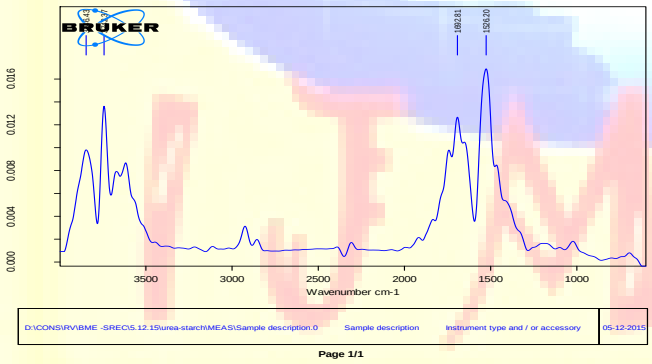

Figure 7: Absorbance spectrum of urea and detergent

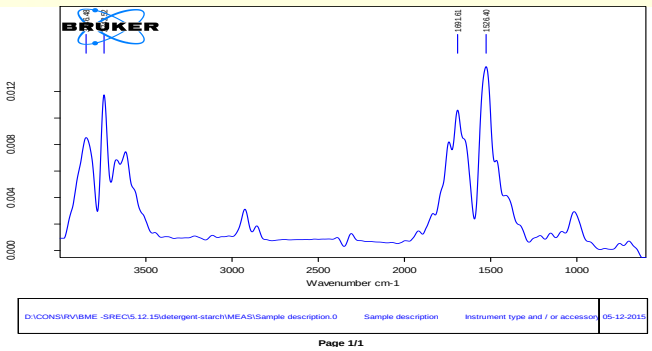

Figure 8: Absorbance spectrum of urea and starch

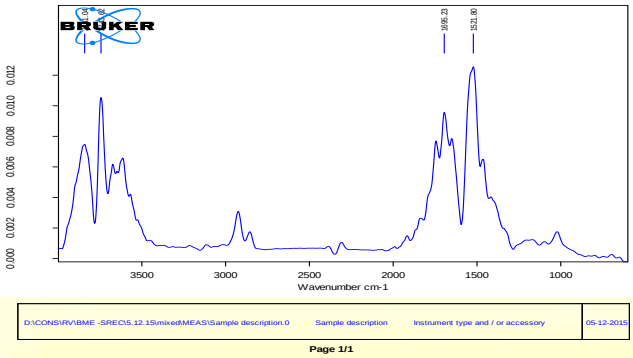

Figure 9: Absorbance spectrum of detergent and starch

The region may be divided into four broad regions: the region of single bonds ranging from 4000 - 2500 cm-1; region of triple bonds from 2500-2000 cm-1; region of double bonds from 2000-1500 cm-1, and the region of other bond deformations (1500-400 cm-1).

B. PARAPHERNALIA FOR THE MODULE:

IR LEDS having a range of above 1600nm and photodiodes are used. In LED electrical energy is converted to optical energy. Emission takes place by the recombination of electrons and holes in a direct band gap semiconductor. This recombination process results in the emission of photons whose intensity is directly proportional to the diode diffusion current which is proportional to the recombination rate. A photodiode is a solid state device which converts incident light into an electric current. When photons of energy greater than 1.1eV fall on the device, they are absorbed and electron-hole pairs are created, which drifts apart when the minority carriers reach the junction. The IR LED and photodiode act as transmitter and receiver for the sensing module.

C. SOFTWARE PLATFORM:

The application was built using Android Studio 1.5 which runs on Java. Android is an operating system based on the Linux kernel. Android Open Source Project (AOSP) primarily lead by Google developed the Android system. The absorbance value from the photodiode is

fed to the arduino, where the values are compared against the normal value that has been previously programmed in it. The mobile application built in the android studio is designed for taking in input from the arduino through a USB cable. The app responds to the input by a text indication about the consumption safety of milk. The emulator chosen here is Nexus 5 with an API 10 running on Gingerbread.

Figure 10: App Icon

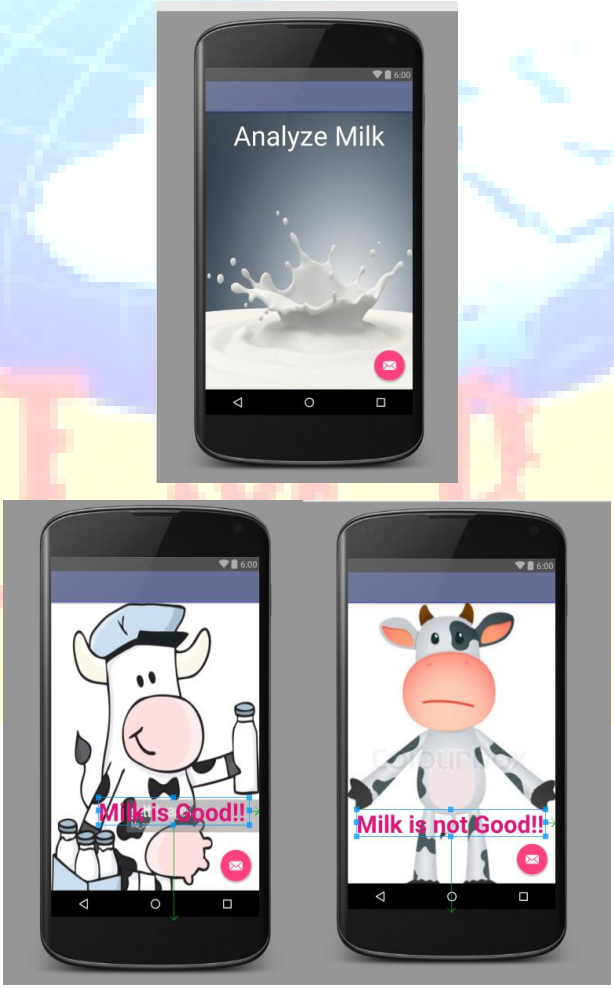

Figure 11: App Layouts

V. RESULTS AND CONCLUSION

The FTIR results of the samples showed varying wavelengths of absorbance. 10 ml of milk sample was mixed with 3.95mg of urea, 2mg of detergent and 0.30 mg of starch respectively. These values are taken as calibration standard for programming the arduino. The spectral absorbance range of all adulterants lie above the mid infra-red range (above 1600nm). Open source mobile application allows testing at households without any constraints. Further research may be carried out for finding the effects of factors like temperature and residual pressure exerted by other gaseous components on the sensor.

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