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A Review on Conventional and Nonconventional Methods for Milk Adulteration Detection

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Abstract: This paper is describing the different types of milk adulteration and the conventional methods which are being used for milk adulteration. To detect the milk adulteration different type of conventional method were identified in past. But in recent past nonconventional methods are being introduced by researched to detect the milk adulteration. Also, it compares all of these methods for detecting the different type of milk adulteration.
Keywords: Milk Adulteration, Synthetic milk, Quality control.

I. INTRODUCTION

In today's world adulteration of food is arising day by day. To earn an additional yield, adulteration is taking place in each every raw material of our day to day routines. Milk is one of the most important essentials of our daily nutrition. Water adulteration had been the oldest method used since very old days. There are plenty of methods being detected for milk adulteration [1], which increases the profit margin. In developing and heavily populated country like India, we are facing the same problem mainly because of two reasons. Firstly, awareness of adulteration in laymen and second the number of collection centers and their remissness. The newer ways are adding detergent, urea and neutralizer [2]. Each of them has their own advantages, But the most threatening technique developed is adding foreign fat in milk, which is a vastly lucrative method and one of the most destructive to our human body.

A. Types of milk adulteration

1) Non harmful Adulteration to human body:

Added water
Mixture of different animal milk

2) Harmful Adulteration to human body

Added urea
Added detergent
Added neutralizer
Added foreign Fat

B. Various method of milk adulteration detection

FSSAI (Food Standard and Safety Association of INDIA) published the methods in the Handbook [1]. Till now number of methods has been found to do the milk adulteration detection. Methods like NIR spectroscopy [3], NMR method [4], Ultrasonic method [5], conductivity method [6] are also being used to detect the Milk adulteration. Whether these are the new methods old and conventional methods are still in use in INDIA.

II. CONVENTIONAL METHODS TO DETECT THE MILK ADULTERATION

FSSAI conducts the survey [7] by taking random sample was taken and analyzed from 33 Indian states. The total sample size was 1791. The study concludes that: Approximately 32 percent of the samples analyzed conformed to Indian food laws. The remaining 68 percent failed, which means that almost 2/3 part of the samples are adulterated. In it Water is milk's most common adulterant. Water reduces the nutritional value of milk and may also spread water-borne illnesses. The second highest parameter of non-conformity was skim milk powder (SMP) in 548 samples, (out of total 1791 samples or 44.69 percent). Of the 548 SMP-positive samples, glucose were present in 477 out of 548 samples (87 percent). Detergent is present in milk. Consumption of detergent-

adulterated milk is a health hazard and indicates a lack of hygiene and sanitation in milk handling.

In year 2002 Hemant kumar[8] there is a new method development to detect the presence of extra amount of urea in milk. As per the Indian national dairy standard the concentration of urea in milk varies in between 0.2 to 0.7 mg/L. Urea will work as preservatives and provides extra amount of SNF (solid not fat), because of that the amount of urea is being added by the farmers to gain profit. Reagent strip was made using Tris-aminomethane and glutraldehyde to detect the amount of urea. As mentioned in paper max value of urea is giving dark pink or the magenta color. The preparation of the dry strip is time taking as well as it requires an expert knowledge of chemistry.

Also FSSAI manual[9] has provided that how the adulteration can be done using the detergent. By adding detergent the value of the SNF can be increased as well as it increases the density of milk. In this section of manual detection method of the detergent is explained. 1 ml Methylene blue dye and 1 ml milk mixed after that 2 ml chloroform is added in test-tube after that the test-tube is centrifuged at 1500 rpm for 15 sec. Dark blue color in lower half of test-tube indicates presence of detergent in milk. If that dark blue color in higher half of test-tube indicates absence of detergent in milk. In the one more section of FSSAI manual[10] is described that to maintain the pH of milk the farmers are using Neutralizer. So that Neutralizer work as one of kind of preservatives, but that can hurt the human body. Here they describe the method to detect the added Neutralizer. The Rosalic method is being used here to detect the Neutralizer. 100 mg of Rosalic powder is dissolved in the 30 ml ethyl alcohol. After that this in 10 ml of milk 0.1% solution is added if the milk is pure there will be brownish color but if it is having alkali is present the red rose color will appear In manual the conventional “Gerber method” is also introduced. 10 ml of Gerber sulfuric acid and 10.75 ml milk is filled up in butyrometer, after that butyrometer is being put in the centrifuge for 5 min at 1200 rpm. This method is quite time taking as well as after the centrifugation there is required of lab operator who see the height of violet part height and by that he decide the value of fat for that particular sample. This method can’t detect the synthetic milk fat saperate from natural milk fat, which inspire to generate new method to detect the fat of milk or to detect the synthetic milk fat directly.

III.NONCONVENTIONAL METHOD FOR MILK ADULTERATION DETECTION

As above discussed that new approach was required to measure the fat of milk, V.R. Singh[12] has identified a new method “Ultrasonic transmission” to identify the value of milk fat. Here the transmission time is being measured by which the value of FAT is identified. A few samples of fluid foods like edible oils were studied to correlate the change in ultrasonic velocity to the amount of adulteration. Ultrasonic velocity **'V'** and density **'p'** were measured at a constant temperature as these parameters are functions of temperature. Processed milk cream sample contaminated with vegetable oil has been studied at a temperature of 304.5 K. Using the below formula relationship was established from the milk fat measurement.

Velocity = distance / transmission time

So that as per change in the percentage of vegetable oil the velocity of the ultrasonic signal decrease as the variation of density as well as viscosity takes place.

In year 2006, Anwar Sadat[13] introduced a diffeSrent physical parameter conductivity (conductance) and capacitance as a quality checking parameter for milk adulteration detection. Specifically, this paper is concentrated for foreign fat of milk. The conductivity measurement is being done based on the two pole cell method. As in conductivity measurement the temperature is having major role so that the temperature is constant for complete experiment at 8 ^{o}C. To get maximum value of conductance as well as the capacitance the experiment was take place for large range of frequency of supply voltage. In the below graph the value of conductance is being measured for various four different milk solution at different value of synthetic milk concentration. Synthetic milk concentration is varied from 0 to 100%, which is having large difference value of conductance as well as the capacitance.

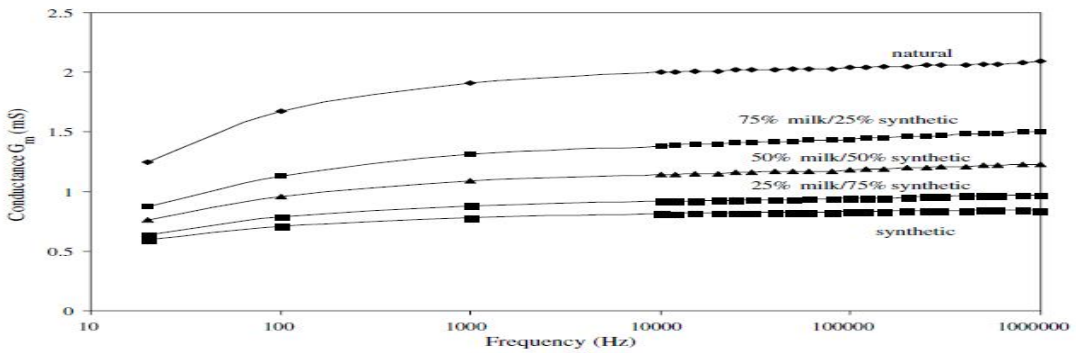

Fig 1 Frequency versus conductance graph[3]

Above graph shows that the value of conductance and capacitance is changed, if there is presence of the synthetic milk in solution. Here value of conductance at different temperature is also being found out at constant supply frequency of 100 kHz and plotted in below graph. The graph shows that the value of the conductance is varied as change in temperature but the gap between the remains easily detectable so that so that by this way we can find the adulteration in milk of foreign fat.

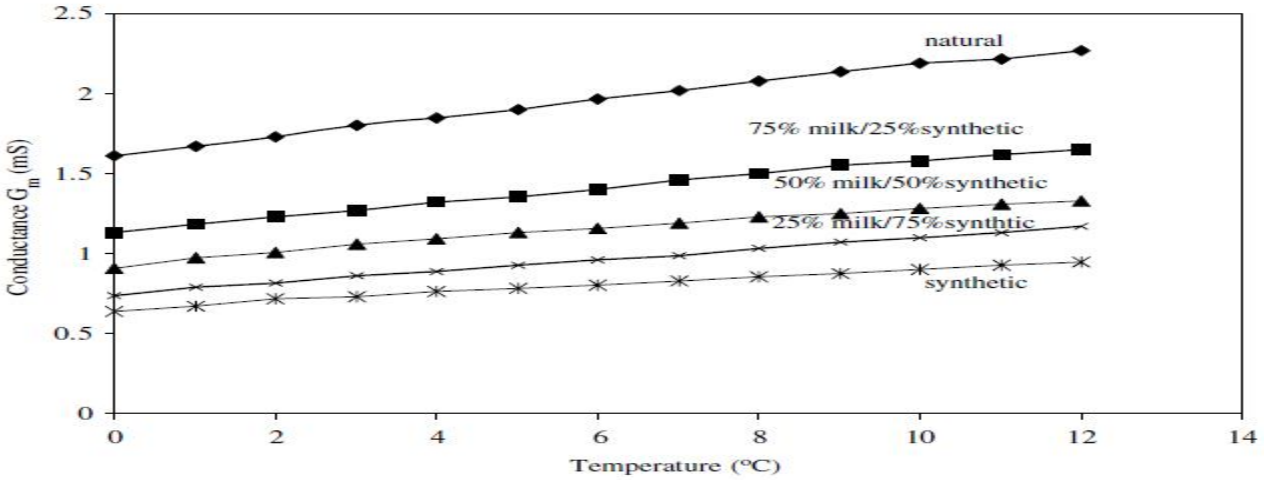

Fig 2 Temperature vs Conductance graph for different samples[13]

In 2003 M.F. Mabrook[14] used conductivity parameter of milk is being observed for the value of added percentage water. Here the experiment had done at 100kHz constant supply frequency and at constant temperature 8 °C which is based on two pole cell method of conductivity measurement. As the below graph shows that there is two milk compression has taken place. In both of the sample the water is being added and conductivity is measured and plotted. The graph is showing healthy change in the conductivity in range of 0 to 35% concentration of water in sample.

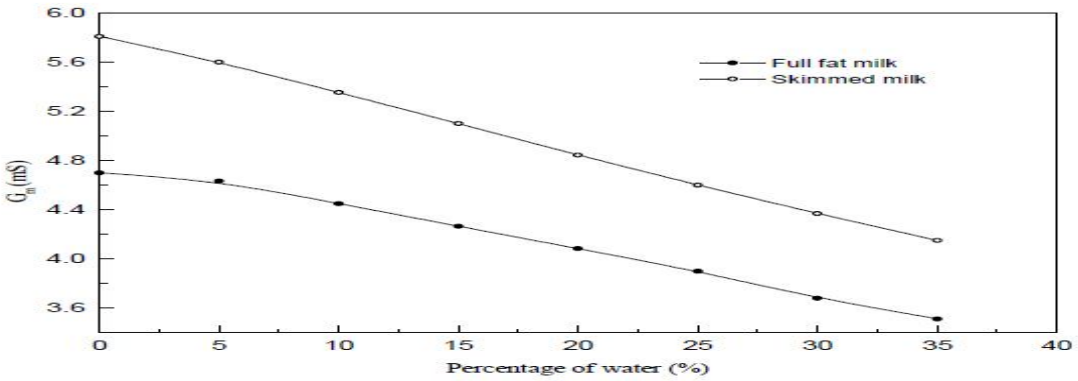

Fig 3 Percentage water vs Conductance[14]

In year 2017 Hui Chen[15] has used the NIR spectroscopy as a tool to identify the melamine presence in the milk. The approach was to detect the melamine by taking 102 samples which are the one of the maximum number of sample taken to identify the adulteration. As protein is also contains the N-H bond same as melamine more than 40 peaks were detected and being used in development of the mathematical model which proved 90% accuracy by comparing which the conventional chemical methods. In 2003 Hans Büning-Pfaue[16] has introduced a method to detect the presence of added water in the food by using the NIR spectroscopy. It has been found that the because of the O-H bond groups which are present in the water, four main maxima located at 970 nm, 1190 nm, 1450 nm and 1940 nm due to O-H bending bond and O-H stretching bond. Here the potato and beef were used as the food product and it finds ou as amount of water increases the absorbance is increases but also there is negligible but detectable phase shift can be identified at where peak absorbance occurs. The same method can be used for the milk to identify the added water quantity. Aernouts, B. and Polshin E.[17] investigated an interesting research on characterizing based on milk NIR spectral information about the metabolism of cow. The composition of produced milk determines the economic value of the milk

and provides valuable information about the metabolism of the corresponding cow. Therefore, online measurement of milk components during milking two or more times per day would provide knowledge about the current health and nutritional status of each cow individually. This information provides a solid basis for optimizing cow management. The potential of visible and near-infrared (Vis/NIR) spectroscopy for predicting the fat, crude protein, lactose, and urea content of raw milk online during milking was, therefore, investigated in this study. Elisângela Serenato Madalozzo & Elenise Sauer & Noemi Nagata[18] has carried out research to determine fat, protein and moisture content in ricotta cheese by NIR spectroscopy with PLSR technique. Spectra of 19 conventional and low-fat ricotta samples from different manufacturers were collected in duplicate, with 33 of the 38 spectra used as a calibration set and the remaining 5 spectra used as an external validation set. They developed robust multivariate model to predict the content of cheese with errors of less than 6.4 %.

IV. CONCLUSIONS

It is observed that Ultrasonic, NIR spectroscopy, AC conductance the nonconventional methods can be introduced and linked with each other to find the strongest out come not only to detect the adulteration in the milk but also to quantify the milk properties as Fat, SNF, Protein and etc. Even the metabolism of the milch animal too. The overtime of the milk also can be identified. Possibly by combining more then 5 or 6 methods and its result with different type of milk samples of raw as well as processed milk it possible to identify the different type of adulteration even if in the presence of neutralizer, which will make novel work in the field of milk industry, even by making a software it can be available to all milk industries and milk vendors, so that even in diverse environmental condition of INDIA and even the various type of cattle milk adulteration can be recognized.

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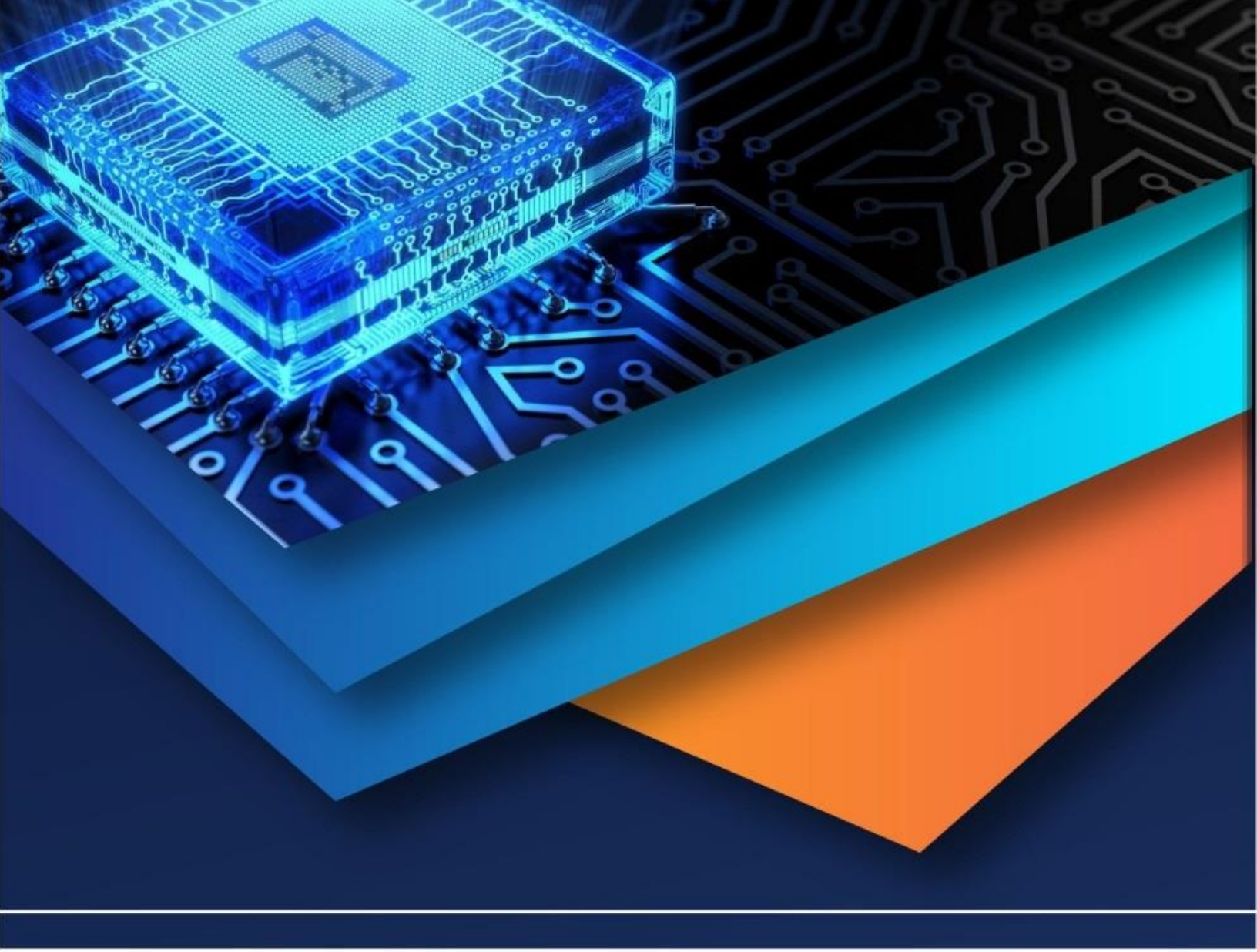

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