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Analysis of Milk Adulteration Using MID-IR Spectroscopy – A Review

Kunal Kishor [1], Ritula Thakur [2].

[1]M.E. Student, Electrical Engineering Department, NITTTR, Chandigarh

[2]Assistant Professor, Electrical Engineering Department, NITTTR, Chandigarh

[1] kunal.elect@nitttrchd.ac.in, [2] ritula.thakur@gmail.com

Abstract — This paper presents the review on different types of milk adulteration based upon conventional method. A straight forward and quick strategy for measurement of milk adulteration has been developed using mid-infrared (MIR) spectrometers. Milk samples was purchased from local supermarkets and spiked with tap water, hydrogen peroxide, glucose, urea and formaldehyde in different concentrations in milk. Spectral data was collected using mid-infrared (MIR) spectrometers. Partial least-square regression (PLSR) has been used to estimate adulteration level and results indicated high coefficients of determination (R^2) and standard error of predication (SEP). The use of Fourier transform infrared (FTIR) spectroscopy coupled with chemo metric techniques to differentiate of milk adulteration. These results proved that FTIR spectroscopy in combination with multivariate calibration can be used for the detection of milk adulteration. The proposed technique is quick, non-dangerous, straightforward and simple to utilize.

Keywords — Adulteration, Multivariate analysis, MIR spectroscopy, PLS, Chemo metric.

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INTRODUCTION

Milk is commonly consumed by people of all age groups. Also, India is the largest producer and consumer of milk. According to a recent report, India is likely to produce 140.6 million tonnes of milk in 2014 and the demand is set to rise to 150 million tonnes of milk. To meet the growing demand, milk and its products have been adulterated to decrease the quality and increase the quantity for economic value. The normal adulterants found in milk are urea, starch/blotching paper, glucose/sugar, harsh pop, refined vegetable oil (modest cooking oil), white paint and basic cleanser or cleanser. These not only reduce the nutritious value of the beverage but also danger to health.

Table 1Comparison of various methods

S. No.	Methods	Advantages	Disadvantages
1	Liquid Chromatography Method	High accuracy, high precision, good linearity, Low uncertainty.	Not portable and expensive.
2	Chemical method	No calibration required.	Human contact with harmful reactants. Wastage of chemicals in testing.
3	Piezoelectric crystal method	Low cost, high DC output voltage when compared to other methods.	Sensitive to stray gases present in the sample.
4	Teflon temperature sensing method	Selective absorption of Ammonia.	Output signal needs to be amplified as it is very low.
5	Electrolytic Capacitance Method	High sensitivity and good reproducibility.	Calibration errors involved.

Milk gives fundamental supplements like (starch, fat, protein, minerals and vitamins) of incredible nutritious importance for people, Generally during childhood. Presently the days event of milk adulteration is a major issue in the dairy industry and has been causing concerns among costumers and food manufacturers. Milk is the seven most basic focuses for defilement by and large refined by the expansion of water, whey, sodium hydroxide and urea.

The use of FT-MIR spectroscopy coupled to chemo metric methods, adopting the specificity of the IR signals for identifying chemical components and the minimal sample preparation needed for the measurements. The instrumental design of FT-MIR spectrometers coupled with chemo metrics methods have also been described and this enable trace level detection and satisfactory analysis. Fourier Transformed Infrared spectroscopy (FT-MIR) has been applied to determine compositional differences between samples on the basis of vibration of various chemical groups at specific wavelengths in the mid infrared region of the spectrum from 400 to 4000 cm^{-1}. Chemo metric methods, especially partial least squares regression (PLS) is among the most commonly used multivariate calibration. The ultimate aim of this paper was to investigate the potential of PLS method coupled with FT-MIR spectroscopy technique, as an alternative analytical tool for non-destructive and fast quantitative determination of added glucose, formaldehyde, hydrogen peroxide and urea in milk.

PROPOSED WORK

Fig. 1 shows the functional block diagram of the proposed work. It consists of light source, interferometer and detector. The sample was placed between interferometer and detector. Ceramic is used to produce infrared light source which fall on the sample, produces corresponding interferrogram in the detector. This interferrogram obtained from the spectroscopy was Fourier transformed and the resultant spectrum was analyzed using chemo metric Technique.

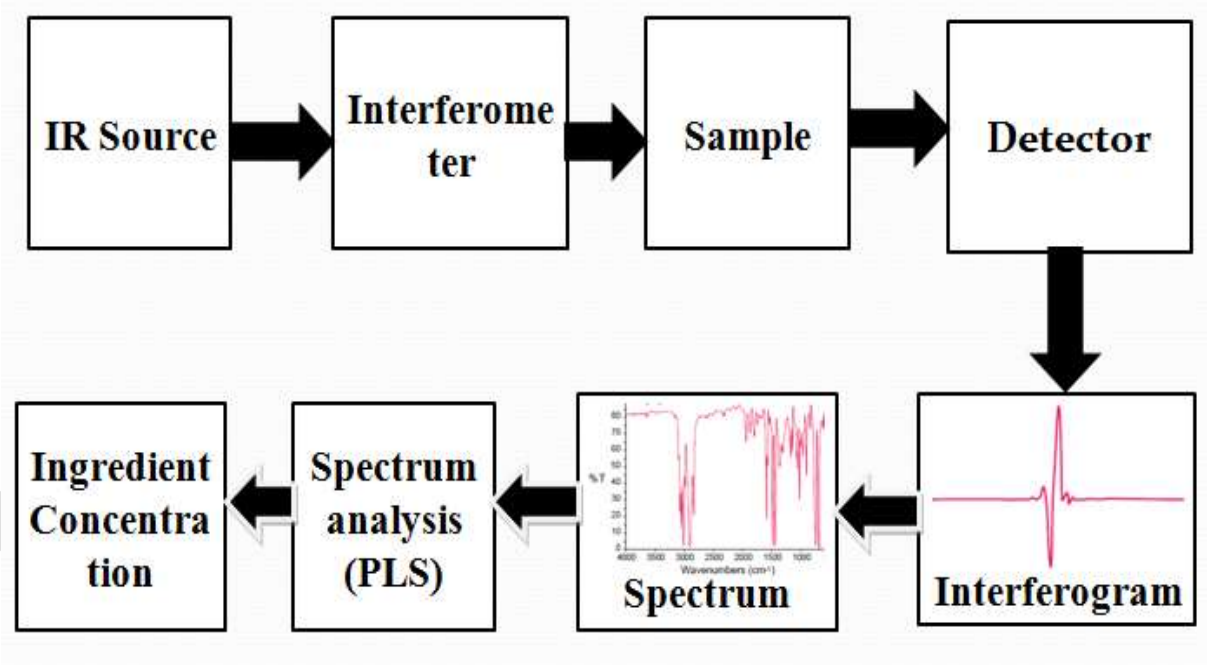

Fig.1 Block Diagram of Proposed Work

CONCLUSION

This paper reviews the milk adulteration based on MID-IR Spectroscopy. The aim of the present work is to be developed a new application of the analytical method association as a rapid, inexpensive and non-destructive authenticity measuring tool useful to determine the adulteration in milk. The results demonstrate a better prediction ability of the PLS technique to determine glucose, formaldehyde, hydrogen peroxide and urea in milk samples. By the use of ATR mid infrared Fourier transform spectroscopy it has been possible to successfully identified the content of adulterant in milk samples.

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