Innovative Techniques to Assess Adulterated Ghee

Heena Kauser[1*], Sapna[1*], Nilkanth Pawar[1*], Sahana V.N.[2*]
[*1]Ph.D. Scholar, Dairy Chemistry Division, ICAR-NDRI, Karnal, India
[*2] Ph.D. Scholar, Animal Genetic and Breeding Division, ICAR-NDRI, Karnal, India
Corresponding Author: kauserh382@gmail.com

Over six billion people worldwide consume milk on a daily basis, despite it being considered a complete food for millennia. Among the essential milk components are fat, SNF, protein, lactose, and ash. A variety of adulterants, including urea, detergents, ammonium sulphate, and neutralizers, were assessed using physicochemical properties

In order to increase profits for dealers, ghee adulteration refers to intentionally mixing pure ghee with inexpensive components of the same type to increase its profits. Ghee is prone to adulteration because of its high price, which includes animal fats, vegetable oil, hydrogenated fats, esterified fats, and mineral oil that is not edible. There are serious issues that need to be properly dealt with in order to identify the adulterations in ghee. Utilising these cheap oils and fats has detrimental health impacts in addition to being prohibited. Media outlets, both print and electronic, routinely report on the adulteration of ghee in India. Adulterations in ghee can be identified using techniques such as chromatographic analysis, spectroscopic analysis, thermal analysis, and physicochemical analysis. These established techniques are pricy, time-consuming, and need substantial sample processing before regular laboratory analysis. Innovative techniques are being utilised more frequently to detect ghee adulteration due to their speed and accuracy.

ATR-FTIR and Chemometrics

ATR paired with transmission, often known as attenuated total reflectance, is one of the most widely used sampling techniques for Fourier transform infrared spectroscopy. In this method, which is based on total internal reflection, infrared (IR) light only interacts with a sample at the point of refraction. Transmission, on the other hand, depends on IR light passing through the sample. An FTIR spectrometer is an extremely useful instrument for determining the chemical composition of organic substances in solid, liquid or gaseous form. Pre-treatment of the samples is necessary for a number of sampling techniques in order to produce high-quality spectra. Measurements of solid or liquid samples can be made using ATR FTIR spectroscopy with only minimal sample preparation.

ATR FTIR spectroscopy requires sample interaction with the ATR crystal. The ATR crystal allows IR radiation to pass through it, which has an impact on the sample surface that is in touch with it. Due to the two materials' differing refractive indices, total internal reflection occurs. This reflection results in the formation of the so-called "evanescent wave" that travels further into the sample. Depending on how the evanescent wave interacts with the sample, a little amount of the infrared light is absorbed, resulting in an attenuated total reflection.

The technique is rapid, non-destructive, and affordable; however, chemometrics expertise is necessary to properly utilise ATR-FTIR's potential.

Recent studies have reported the addition of coconut oil, goat body fat, and pig body fat to ghee using ATR-FTIR and chemometrics. First, spectra of pure ghee and the powerful adulterant, coconut oil, were taken in the wavenumber range of 4000 to 500 cm-1, together with samples that had been spiked. Furthermore, a wavenumber range of 1170-1141 and 1117-1100 cm-1 was selected, and principal component analysis (PCA) of the samples showed distinct groupings for pure ghee and contaminated samples. Soft independent modelling by class analogy (SIMCA) was successful in classifying the pure ghee and coconut oil samples of the confirmation set using both the principal components regression (PCR) and partial least squares regression (PLS) models. The study found that it is possible to detect counterfeit coconut oil samples in ghee at a concentration of just 2%.

Electronic Nose System

An electronic nose (e-nose) based on MOS gas sensors was developed to detect adulterated ghee with hydrogenated fat (vanaspati). To find ghee adulteration, the data from the e-nose system was analysed for pattern recognition and classification. Principal component analysis (PCA) and discriminant function analysis (DFA), two techniques for multivariate chemometric analysis, were examined. The PCA and DFA each explained 98.10% of the variance in the e-nose dataset. The accuracy of cross-validation results and training data was found to be 98.18% and 97.27%, respectively. Based on the e-nose signals that were received, the DFA model was successful in identifying adulteration in 90.90% of the sample. It indicates that the developed e-nose system successfully differentiated between pure and contaminated ghee samples based on the e-nose data, PCA, and DFA results.

Gas Chromatography

Researchers generated samples of cow and buffalo ghee using milk gathered from areas in the eastern, western, southern, and northern sections of the nation. The triglyceride content of ghee that had been made in this way was determined using gas-liquid chromatography, and S-limits were computed using the equations outlined in the ISO technique. Cow and buffalo ghee samples from all four locations both fell outside of all five S- limits, as stated in the standard for cow milk, on both the lower and upper sides of the limits.

It was discovered that samples of buffalo ghee had a greater. In samples from all four regions, the maximum S-total (ST) limit ranged from 109.34 to 118.21, but the lower value for buffalo ghee samples from the eastern, northern, and southern region samples was a little lower (94.06 to 94.59) than the lower range indicated in the standard. When the S-limit (S4) required for the detection of palm oil and beef tallow was used, a similar pattern was seen. The S- values in cow ghee also displayed a tendency to deviate from the norm.

Chromogenic Test

To evaluate the quality of ghee in routine quality control analyses, simple and quick tests are currently utilised. Currently, a DPPH-based chromogenic test is being utilised to detect palm oil in ghee. The experiment used a 50 mg/100 ml (ethanol) DPPH solution. This assay's specificity was evaluated using pure ghee and palm oil. Up to 5% of adulterated palm oil in ghee appears to be detectable by the technique. A platform test for routine quality analysis may be used because the designed procedure was effective, reliable, and sensitive. milk food testing facility.

Conclusion

The current issue has impacted the dairy industry's reputation both domestically and internationally. The different instances of adulteration documented in the literature were utilised to gauge the severity of the issue. Finding adulterants in ghee utilising a variety of quick, creative methods could raise awareness of the need to preserve the ghee's typical quality. Their methods might be put to use in research labs or other labs, which could generate financial resources. Even though the initial expenditure is more for some techniques, such FTIR and electronic systems, it is a quick way to find adulteration in ghee.

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