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International Journal for Modern Trends in Science and Technology, 7(03): 201-204, 2021

ISSN: 2455-3778 online
DOI: https://doi.org/10.46501/IJMTST0703033
Available online at: http://www.ijmtst.com/vol7issue03.html

Detection Methods of Non-permitted Food Color, Metanil Yellow: A Review

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To Cite this Article
Parag Chattopadhyay, Aditya Paul, Samridhya Paul, Sukanya Ray and Kakali Bandyopadhyay, "Detection Methods of Non-permitted Food Color, Metanil Yellow: A Review", *International Journal for Modern Trends in Science and Technology*, Vol. 07, Issue 03, March 2021, pp.: 201-204.

Article Info
Received on 15-February-2021, Revised on 12-March-2021, Accepted on 17-March-2021, Published on 20-March-2021.

ABSTRACT

Food adulteration is a primary global concern for public health, especially in developing countries, due to the lack of monitoring and appropriate policy developments and executions. Due to its high demand in international trade, turmeric (Curcumina Longa) is subjected to economically motivated chemically unsafe adulteration, namely metanil yellow. Metanil yellow (3-4)-anilinophenylazo) benzene sulfonic acid sodium salt), is a hazardous dye and a common adulterant used in turmeric powder and other yellow colored food products. The toxic chemical travels in blood and reaches various organs and interferes with various cellular metabolic processes there. Our earlier studies reveal that metanil yellow generates oxidative stress in various vital organs such as heart, liver, and kidneys. As per the guidelines of food quality some conventional methods are used but these techniques possess various limitations. This study aims to review the use of FT-Raman and FT-IR spectroscopy for evaluation of metanil yellow in turmeric powder.

KEYWORDS: *Non-permitted food colors, metanil yellow, turmeric powder*

INTRODUCTION

There are several types of dyes used as food additives and food colorants. Metanil yellow is a yellow dye used extensively as a food colorant. It is made from diazotized metanilic acid and diphenylamine [1]. Azo dyes are also used in laboratories as biological indicators. Turmeric (Curuma long L.) is an appetizing root commonly used for food seasoning and for medicinal purposes. Turmeric has a long history of medicinal use in Asian countries (Reema F Tayyem et al. Nutr Cancer. 2006[2]) and is used in root, oil, and powder forms. Its medicinal value is mainly due to its content of curcumin (diferuloyol methane) (T Osawa et al. Biosci Biotechnol Biochem. 1995 Sep [3]) with attributed medical properties including anti-inflammatory, anticarcinogenic, antioxidant,and wound-healing effects(B Joe et al. Crit Rev Food Sci Nutr. 2004[4]). Curcumin has also been reported to have promise for development of therapies for Alzheimer's disease (Tsuyoshi Hamaguchi et al. CNS Neurosci Ther. 2010 Oct [5]).

According to the sources it has shown that the nutrient and acidity content in soil, fertilizer, soil type and cultivar affects the curcumin content in turmeric. Reported curcumin concentrations in turmeric range from 0.3% to 8.6% [3,6-9]. Curcumin is isolated from turmeric for medicinal and cosmetic purposes. Although whole, dried, or fresh turmeric are mostly free of contamination, turmeric powder can be deteriorated with different chemical powders used as substitutes for curcumin (Sasikumar.B et al. 2004 [10]). It has been using in many unorganized

sector such as in local sweet shops and marketed in the rural areas in West Bengal, India [11]. And the lost vital fact is it has been declared under the act prevention of food adulteration of India (2008) that presence of metanil yellow is over permissible limit [12]. Metanil yellow (C18H14N3NaO3S) is a toxic azo dye that has been added to turmeric powder to mimic the appearance of curcumin [12,13,14]. But the actual content of circumin is very low [15]. Toxicologically, metanil yellow is classified as a CII category substance by the Joint FAO/WHO Expert committee on Food Additives, and it inferred that it is a compound for which virtually no information on long-term toxicity is available(L P Srivastava et al. Environ Res. 1982 Feb[16]). A variety of conventional methods have been effectively used for detection of metanil yellow in food stuffs. Ion-pair liquid chromatography detected with 99% linearity the presence of azodyes, such as metanil yellow, in the range of 0.05 ppm to 10 ppm in food (Ming-Ren Fuh et al. Talanta. 2002[17]). Clearly, the relative value of optical methods has putten the increasing use for safety and quality detection of foods and sub-products. This study made use of FT-Raman and FT-IR spectroscopy for evaluation of metanil yellow in turmaric powder. Analysis expressed that the FT-IR method could detect the metanil yellow at the 5% concentration, while the FT-Raman method resulted to be more sensitive and could detect the metanil yellow at the 1% concentration (Sagar Dhakal et al. Foods. 2016 [18]). Relationships between metanil(yellow) spectral peak intensities and metanil yellow concentration were established using picturisation peaks at FT-Raman 1406 cm−1 and FT-IR 1140 cm−1 with correlation coefficients of 0.93 and 0.95, respectively (Nathalie Mainreck et al. J Pharm Sci. 2011 Feb[19]).Although FT-IR and FT-Raman spectroscopy have not been previously reported for detection of metanil yellow adulteration in food, these spectroscopy methods have been widely used for detection of other food adulterants. Our paper on this review is meant for abstracting the various evil effects on human health due to utilisation of metanil yellow as food colorant or additive by human beings, This study also presents a comprehensive study of FT-Raman and FT-IR spectra of metanil yellow at different concentrations.

EFFECTS ON HUMAN BODIES

Utilization of metanil yellow in food can or may affect our nervous system and cause brain damage. Studies show that exhibition to metanil yellow terminates adult as well as developing brain in Wistar rats [20]. It was found that amine levels (neurotransmitters) in certain areas of brain such as the stratum and brain stem were markedly effected with oral administration of metanil yellow. Such changes were observed in hypothalamus also. After withdrawal of metanil yellow administration, the adverse changes in levels of neurotransmitters were not reversed [20]. Research shows that metanil yellow causes gastic problems and damages the intestine Metanil yellow also caused erosion and degeneration of gastric glands. In the intestine, it was observed that metanil yellow exposure loosened the structural configuration of absorptive columnar epithelial cells. Intestinal microvilli were also declared to be unsettle heavily due to metanil yellow exposure. All those caused loss of absorption capacity of nutrients [21]. Studies in fish model shows that extensive degeneration of cytoplasm, pyknosis of nuclei and damage occurred in central vein region of liver tissue on metanil yellow exposure.[21]

METHODS

1. FT-Raman and FT-IR Spectroscopy

The FT-IR module consisted of a triglycine sulfate (DTGS) detector with KBr beam splitter for collection of sample spectra in the spectral range of 650 cm−1 to 4000 cm−1. The attenuated total reflection (ATR) technique was utilized for FT-IR spectral collection. A small amount of the sample was placed on the Germanium crystal of the ATR device pressurized by pointed tip to ensure uniformity in surface area of contact between the Germanium crystal and sample. A background spectrum was first acquired with the empty Germanium crystal prior to spectral collection of the sample. The crystal plate and pointed pressure tip of the ATR device was cleaned thoroughly using cotton soaked with methanol after spectral acquisition of each sample. An average of 32 successive scans at 4 cm−1 intervals were acquired and saved (“comma separated values” format) for further analysis. The FT-IR spectral signal of three replicate samples were acquired at each concentration level [18].

RESULTS AND DISCUSSIONS

By looking at the structure of both metanil yellow and turmeric we found out that due to extended conjugation in degree responsible for the yellow color present in them. With concentration. The experimental spectral regions mostly show

uniqueness to each component, and preferably with the highest relative intensity, can be used to accurate projection the presence of metanil yellow in turmeric.

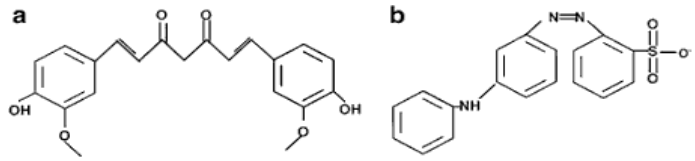
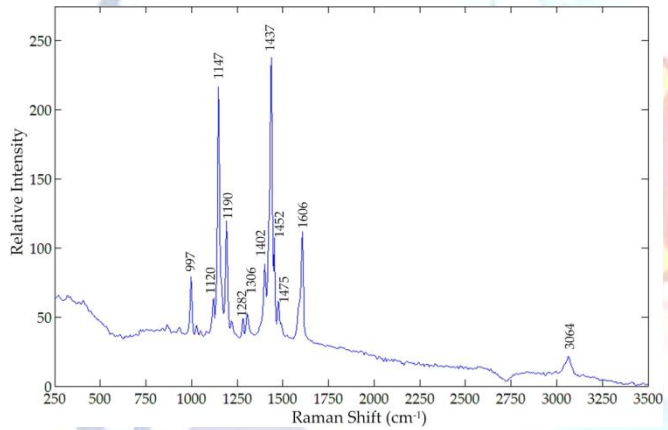
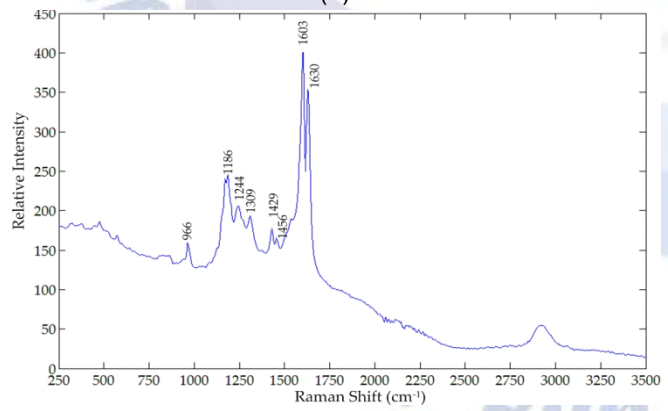


Figure 1 - structure of Metanil Yellow(b), turmeric(a)

As by looking at the structure of both metanil yellow and turmeric in figure 1[26], they both are different and dissimilar and the vibrational modes specific to precisely their slietly different chemical structures. Because we didn't have the device to confirm the actual readings and results, so the results and data are totally collected as because of the courtesy of [18]. so that we can show exact showcase of this evidence.



(a)



(b)

Figure: - FT-Raman spectra of: (a) Metanil yellow; (b) Turmeric powder

CONCLUSION

From the above study, it can conclude that rapid color test and thin layer chromatography can be used as a preliminary test for the detection of adulterants for metanil yellow. For further confirmatory study the analytical tests are performed, using the method of FT-Raman and IR-spectroscopy. In the recent years, synthetic yellow food colors are frequently used in different varieties of food item to make them more attractive to the consumers. The ornamental value thus reduces the qualitative value of the food. In such a scenario, the adulterant imposes serious threats to human leading to severe diseases like cancer. Also, in general cases it alters the normal functioning of the body. Advanced studies have also showed that FT-Raman and FT-IR spectroscopy has been effective in detecting mentanil yellow, turmeric and curcumin. FT-Raman method was able to detect 1% concentration of metanil yellow and FT-IR method was able to detect 5% concentration. Thus, both were developed to detect the peak values of metanil yellow as well using the band ratio model. Thus, this method has been considered as a boon to mankind as it detects carcinogenic metanil yellow in turmeric.

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