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Toxic Effect of Metanil Yellow As Food Adulterant: A Review

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ABSTRACT

Metanil yellow used as food colorant extensively used in various foods as an adulterant in different food substances such as turmeric, pulses, candy and ice-cream to provide a bright fresh colour to them. It belongs to non-permitted category of food colour as continued intake of this toxic food colour causes to adverse life –threatening effects in humans. Numerous studies conducted and reported the health issues related to metanil yellow. Awareness among general public should be increased regarding its toxic effects and use of metanil yellow in food materials should be completely banned.

KEYWORDS: Adulterant, metanil yellow, toxicity

INTRODUCTION

There are numbers of dyes used in food as additives or for coloring purpose. The metanil yellow, an azo dye is widely used as a food colorant. This is formed by diazotization of metanilic acid and diphenylamine. [1]. Use of metanil yellow for industry purpose such as coloring different types of fibres, paper, detergent, metal (Al) etc. is allowed. However, use of this yellow dye is prohibited in foodfor its toxicity. Even though it is extensively used in food products as colorant for its cheap value. [2]. Various studies revealed that the use of metanil yellow has toxic effect on human health. [2,3,4]. The mechanism behind is that the metanil yellow gets absorbed through intestine and enters the bloodstream when consumedwith food. These toxic chemicals from the blood further passes to different organs and shows their adverse effect by interfering with the metabolic processes of organs. Metanil yellow produces oxidative stress in organs such as liver, kidneys and heart. [5,6]. Various studies revealed that food products such as turmeric and ladoo, a sweet, made up of gram powder marketed in rural areas of West Bengal, India and processed by unorganized sector mostly consist of metanil yellow to provide a fresh yellow look

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to such food products. The metanil yellow detected in such food products are found to be more than the permitted values provided in the prevention of food adulteration act, India, 2008. [2].

Studies showed that adulteration of food products, known for their medicinal values, such as turmeric powder and honey pose great threat to human health when consumed for long period of time. [2,8]. These adulterated medicinal values food stuffs are regularly consumed by people unknowingly causing adverse effects on their health as the toxic azo dye enters the body regularly in little amount causing chronic poisoning of metanil yellow. [2,3,4,5,6,7]. It causes damage in various vital organs such as liver, heart, kidneys, intestines, nervous tissues, etc., and all vital organ system of human body. [2-6].

Study conducted on adult male albino rats by maintaining some of them at normal condition, by feeding metanil yellow with food products at a dose weight of fifty, hundred and two hundred mg/kg of body weight and to the third group after giving metanil yellow orally at the prescribed dose treated them with honey produced by honey bees with the dose of 2.5 mg/kg of body weight regularly and found that there were no significant difference in the initial & final body weights of controlled and treated rats, but a continuous and marked decrease in weight of body of rats treated with metanil yellow and a marked increase in the final body weight of albino rats treated with honey. [12]

Study proposed that metanil yellow can be detected using FTIR due to the presence of three nitrogen atoms and one sulphate group and absence of any methyl group. The absorption peak for metanil yellow correspond to the range of 1000 nm -1200 nm (2^{nd} overtone region of nitrogen-hydrogen bonds) & 1350 nm – 1550 nm (1^{st} overtone region of nitrogen-hydrogen bonds) and thus resembles secondary amine. [23]

Study utilized techniques FTIR & FT-Raman spectroscopy to detect presence of metanil yellow in turmeric and observed that use of FT-Raman provides the absorption peak at 1406 per centimeter and with FTIR, it is 1140 per centimeter at one percentage and five percentage of concentration limit respectively. [31]

Study conducted on pure and adulterated solutions of turmeric powder using UV-Visible spectroscopy at region between 250-550 nm and FT-MIR spectroscopic technique at range between 1800 – 700 per centimeter reported that the comparative absorption of pure turmeric and metanil yellow observed at the range of 350 nm to 550 nm and provide an absorbance peak for presence of metanil yellow content at range of 442 nm. Use of FT-MIR revealed increased absorption capacity with increase in content of metanil yellow. The pure turmeric powder provides the absorbance at 420 nm and for the metanil yellow the peak was found to be at 445 nm. [32]

This review is to summarize the adverse effects of metanil yellow on human health due to its consumption as food additive or colorant by humans and to provide the preventive measures that

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can be taken against its ill-effect on human health. Serious measures such as awareness, precautions and preventions should be taken at public and administrative level to ban the use of non-permitted metanil yellow as food colorant or additives.

Effects on Nervous System

Metanil yellow on the consumption can affect the nervous system causing brain damage. Studies revealed that exposure to metanil yellow causes damages to adults and also to developing brain of Wistar rats. [4]. The level of amine, the neurotransmitters, were highly affected in certain areas of brain such as brain stem and stratum because of oral consumption of this azo dye. These changes can be seen even in hypothalamus. Even after stopping the administration of metanil yellow the effects on nervous system has not came to their normal position as it was before. [4]. Acetylcholine esterase level gradually decrease with the consumption of metanil yellow and observed a delayed decrease in hippocampus of Wistar rats. Learning was even affected in rats with metanil yellow exposure. [4].

Other studies show the adverse effects of metanil yellow consumption such as damages in the granular and Purkinje cell layer of brain. Marked histopathological changes were seen in brain tissues of rats associated with long-term consumption ofmetanil yellow. [8]

Effects on Digestive System

Studies show that consumption of metanil yellow causes liver toxicity, damages to the intestine when it directly enters to the digestive system with food stuffs. [5]. Studies conducted on fish reveal that exposure to metanil yellow causes disturbance and disarrangement of gastric folds, damage epithelial cells, and fragmentation. It also caused destruction and degeneration of gastric glands.Studies show that exposure to metanil yellow causes loosening of structural configuration of absorptive columnar epithelial cells in the intestine. Microvilli present in the intestine also get extensively disturbed due to consumption of metanil yellow causing interruption inthe absorption power of nutrients. [8]. The fish model studies reveal that exposure to metanil yellow causes extensive destruction of pyknosis of nuclei, cytoplasm and damages to liver tissues at central vein region. [8].

Effects on Cardiovascular System

Exposure to metanil yellow causes damages to heart tissue and also causing cardiac toxicity. [6]. Study reveal that metanil yellow induces the lipid peroxidation level and also changes the endogenous antioxidant enzyme level and catalase enzyme in a study conducted in vitro in goat heart.

Effects on Excretory and Reproductive System

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A study conducted on fishes suggested that use of metanil yellow induces histopathological lesions in kidneys. [8]. The prolong use of metanil yellow causes death of tubular epithelium, interruption of Bowman's capsule & enlargement of epithelial cells of renal tubules. Various detrimental changes were seen in tubules of kidneys such as convoluted & distal. [8]

Studies reported that metanil yellow induces testicular tissues damage in albino rats and depletion of spermatocytes and seminiferous tubules. [10]. In gametogenic elements, metanil yellow found to cause damages in testicular region reported by the study conducted on rats, guinea pigs, & mice. [11]

Exposure of metanil yellow is detrimental to both male & female reproductive system. It causes disruption to estrus cycle in rats (female). [2] It also inhibit the production of follicule-stimulating hormone & estradiol in the ovaries and causes oxidative stress at axis of hypothalamic-pituitary-gonads. [2]

Conclusion

It can be said that metanil yellow, an azo dye is widely used in food stuffs as a colorant even when people are aware of its harmful effect on human health and also causes fatal hazards such as cancer. Various mechanism studied behind its toxicity but this work reported that one of the mechanisms behind it can be introduction of oxidative stress. [5,6]. Serious measures such as preventions, precautions and regulations of prohibited metanil yellow should be adopted and use of this toxic yellow dye in consumption should be prohibited. It leads to the degeneration of antioxidant system naturally present in body and produce free radicals. To combat the severe effect of metanil exposure, consumption of antioxidant food products in daily basis diet should be increased. [5,6]. Use of food colorant such as metanil yellow i.e. toxic in nature should be completely banned and further use of any additives in manufacturing of food should be examined and regulated closely.

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