

Metanil yellow: The toxic food colorant

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ABSTRACT

Metanil yellow is a food colorant used extensively in various foods. It is also used as an adulterant in different spices especially turmeric and regular Indian foods like pulses. Metanil yellow belongs to “non-permitted” category of food color. Continued consumption of this toxic food color leads to adverse life-threatening effects in humans. There are studies revealing adverse health effects of metanil yellow. Serious concern and mass awareness are needed to be raised on the issue, and use of this toxic food color needs to be abandoned completely.

Key words: Metanil yellow, food adulterant, health

INTRODUCTION

There are several types of dyes used as food additives and food colorants. Metanil yellow is a yellow azo 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, as pH indicators and for the purpose of research. Metanil yellow is allowed for use in industries for coloring wool, nylon, silk, paper, ink, aluminum, detergent, etc. The dye is not permitted for use in food materials. It is toxic and is banned for use in foods. However, the toxic chemical azo dye is used widely as a coloring agent in various food stuffs as it is a cheap food colorant.^[2] Studies reveal that the dye has a toxic effect on various physiological systems.^[2-4] The suggestive mechanism can be that metanil yellow gets absorbed from the intestine if consumed with food and enters the bloodstream. 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.^[5,6] Studies show that certain food products such as turmeric powder and laddoo besan processed by the unorganized sectors and marketed in the rural areas in West Bengal, India, mostly contain the metanil yellow. The presence of metanil yellow as found to be above the maximum permissible limits as provided in the prevention of food adulteration act of India (2008).^[2]

Studies reveal that adulteration of useful food stuffs such as turmeric and honey which are considered for their medicinal values impose adverse health impacts on long-term consumption.^[2,8] People consume those foods for their known medicinal values. However, unknowingly, the toxic food colorant, metanil yellow enters their body regularly, and thus their health gets dangerously effected due to chronic exposure to metanil yellow.^[2-6] Metanil yellow can induce damage in heart, liver, kidneys, nervous tissue, intestines, gastric tissue, etc., all vital organs and organ system of humans.^[2-6]

Our this review is meant for summarizing the various evil effects on human health due to consumption of metanil yellow as food colorant or additive by human beings. We have also tried to bring in front the possible preventive measures against metanil yellow induced adverse health ailments. Awareness, precautions, prevention, and serious measures at public and administrative level are essential to prevent the use of this non-permitted toxic food colorant.

Effects on Nervous System

Consumption of metanil yellow in food may affect our nervous system and may cause brain damage. Studies show that exposure to metanil yellow damages adult as well as developing brain in Wistar rats.^[4] 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.^[4] A delayed but persistent decrease in the level of acetylcholine esterase level was observed in the hippocampus of Wistar rats with metanil yellow exposure. It was also observed that learning was adversely effected in rats with metanil yellow administration.^[4] Other studies reveal that exposure to metanil yellow caused damages in both the granular and Purkinje cell layer of brain. Remarkable histopathological changes were observed in brain tissue of rats on long-term exposure to metanil yellow.^[9]

Effects on Digestive System

Metanil yellow consumed through food enters our digestive system directly. Studies reveal that metanil yellow causes gatrotoxicity, hepatotoxicity, and damages the intestine. Studies conducted in fish model (*Heteropneustes fossilis*) show that metanil yellow exposure caused disruption and disarrangement of gastric folds, destroyed the epithelial cells, caused loss of microridges from the apical plasma membrane and fragmentation. Metanil yellow also caused erosion and degeneration of gastric glands. In the intestine, it was observed that metanil yellow exposure loosened the structural

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configuration of absorptive columnar epithelial cells. Intestinal microvilli were also observed to be disrupted heavily due to metanil yellow exposure. All those caused loss of absorption capacity of nutrients.^[10] The lamina propria was also severely necrosed with metanil yellow.^[10] We observed in our earlier studies conducted that metanil yellow administration caused hepatotoxicity.^[5] 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.^[10]

Effects on Cardiovascular System

Our studies on goat heart shows that metanil yellow induces damage in heart tissue and causes cardiotoxicity.^[6] Metanil yellow has been found to raise the level of lipid peroxidation and also altered the level of the endogenous antioxidant enzyme, catalase in goat heart *in vitro*.^[6]

Effects on Excretory and Reproductive System

Studies conducted in fish model reveal that exposure to metanil yellow caused histopathological lesions in kidneys.^[9] In kidney, necrosis of tubular epithelium, cloudy swelling of epithelial cells of renal tubules and disruption in Bowman's capsule were also prominent features of toxicosis.^[9] Necrosis of tubular epithelium, disruption in Bowman's capsule and swelling of epithelial cells of renal tubules were observed with metanil yellow exposure. Several deteriorative changes were observed in the distal convoluted tubule and the collecting tubules in kidneys.^[9]

Metanil yellow has been found to be toxic to both male and female reproductive system. It has been reported that metanil yellow can disrupt the normal estrous cycle in female rats.^[2] Metanil yellow impaired folliculogenesis in female rats and also has been found to inhibit the secretion of FSH and estradiol from the ovary, and induce oxidative stress in hypothalamic-pituitary-gonadal axis.^[2]

Studies conducted on albino rats show that metanil yellow causes damages to testicular tissues. It was found that metanil yellow induced degenerations in the seminiferous tubules and the spermatocytes. Vacuolations were also shown in the sertoli cells with metanil yellow exposure.^[11] Metanil yellow has also been reported to cause testicular damage in gametogenic elements in guinea pigs, rats, and mice.^[12]

CONCLUSION

It is thus obvious that the toxic food colorant, metanil yellow is in wide use in preparation of various food items. In spite of knowing the fact that the azo dye is extremely harmful for our physiological system and can induce fatal health hazards like cancer the toxic food colorant metanil yellow is still in use. The probable mechanism underlying the toxic effect of metanil yellow may be multiple, but our studies show that induction of oxidative stress is one of such mechanism.^[5,6] Metanil yellow disrupts the indigenous antioxidant system and also induces generation of free radicals. Thus, consumption of antioxidant may help to alleviate the situation.^[5,6] Proper precautions must be adapted, colored food consumption must be restricted, and enough antioxidants must be included in regular diet to combat adverse health conditions due to consumption of toxicants like metanil yellow. Furthermore, use of the toxic food colorant should be banned, and proper monitoring is necessary to assure no further use of the colorant in food manufacturing.

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