

## Short Communication

## Sub-Chronic Effects of Sodium Metabisulfite on the Intestinal Microarchitecture of Mice



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## Competing interests

The authors have declared that no competing interests exist.

## Abstract

**Background:** Sodium metabisulfite (SM) is commonly used with varying concentrations as a preservative, sewage treatment chemical, and in other commercial consumer products etc. It is reported to pose series of health hazards affecting various vital organs. The current study was aimed to find histological alterations in the intestine with sub-chronic exposure of SM in albino mice.

**Materials and Methods:** Ten mice were orally given SM (1.2 mg/kg mixed in 0.1 ml corn oil) for 21 days while ten mice were kept in the control group (no SM). All the mice were dissected, and small intestine pieces were excised and processed for histological sectioning and staining.

**Results:** SM disrupts the outer wall of villi and microvilli of the small intestine. Moreover, a narrow lumen and few mitotic figures were seen in the intestinal glands.

**Conclusion:** The results concludes that SM is a potential source of major organ's defects and hence its usage should be lessened to improve the health status.

**Key words:** Intestinal architecture, Sodium Metabisulfite, Sub-chronic response

## Introduction

Sodium metabisulfite; (SM) ( $\text{Na}_2\text{S}_2\text{O}_5$ ), is an inorganic compound widely applied as a disinfectant, biocide, pharmaceutical, antioxidant, and preservative agent with extensive usage to enhance the shelf life of meat products and even in water and sewage treatment of plants (Barberá et al. 2000).

Due to the widespread commercial application of the SM, many workers reported it to become a part of the food chain, which directly or indirectly harms humans. (Noorafshan et al. 2014). Naureen et al. (2021) reported damaging effects of SM on reproductive hormones in male mice wherein a sharp decrease in the level of testosterone was noted along with deformities in the liver tissue with significant decrease in glutathione and an increase in Malondialdehyde level was also observed. Yoo et al. (2018) investigated the cytotoxicity of SM and propylene glycol in a sub-acute exposure in rats. Toxicity of the chemicals was observed separately and also in the form of mixtures whereas inhalation of SM at a high dose caused a decrease in the weight of animals.

The Food and Drug Administration of the USA on July 9, 1986, banned the use of sulfite preservatives in fresh fruits and vegetables since sulfites have been linked to 13 deaths and several illnesses, mainly among asthmatics. Due to its anaphylactic reactions, its use is limited in several countries like Australia and the USA (Yang and purchase 1985).

SM can affect some important organs of the body and reported a 20% decrease in ventricle tissue and 43% decrease in capillary length and volume in sulfite-treated rats (Noorafshan et al. 2014). SM also was reported to trigger asthma in female asthmatic patients through the induction of bronchoconstriction (Vally and Misso 2012). The previous report has shown that the response to SM occurs as a result of the effect of sulfur dioxide, which affects the sensory nerves and cause the release of the mediator (Wright et al. 1990). According to the previously reported literature,

we hypothesized that SM may have lethal effects on the organs like small intestine, the current investigation was therefore aimed to find the effects of SM on the intestine considering its role in absorption, in albino mice.

## Materials and Methods

### Animals

Male albino mice (n=20) were reared under controlled environmental conditions for acclimatization until (weight of  $30 \pm 0.2$ g). Approved institutional guidelines by the Local Ethical and Review Committee of the University of Okara, Okara, Punjab, Pakistan was followed.

### Experimental design & animal processing

The mice were randomly assigned into two groups, a control group (n=10) and an experimental group (n=10). The experimental group was given sodium metabisulphite (1.2mg/kg mixed in 0.1ml corn oil) twice a week for 21 days through oral gavage, while the control group received 0.1ml of corn oil with the same time regime similar to experimental group. After completion of experimental period, all the animals were dissected to excise the intestine followed by histological sectioning, staining with H & E and microscopic analysis as described by Abbasi et al. (2014 & 2018).

## Results and Discussion

The present study investigated the histopathological changes in the intestinal tissues of albino mice that were treated with SM. Since, small intestine performs absorption and SM is a widely used food preservative it can potentially damage the small intestine. Several investigators reported the effects of various doses of SM on various animal models (Elmas et al. 2005) However, sub-chronic inflammatory mice model has been less studied.

Figure 1 A&B showed hematoxylin and eosin-stained small intestine section of the control group with inset 40 $\times$  revealed normal histological findings with each villus (v) lined with simple columnar epithelium (CE) with uniform and continuous striated border of microvilli (MV) (Figure 1B). Inset 40 $\times$  of Figure 1D, highlighted broken parts (BP) of villi. Disruption of outer wall (DW) was also noted. An overall disruption in the intestine villi might be due to degeneration of epithelium of the villi and reduced vascular density due to SM. Inset 40 $\times$  of Figure 1E highlighted the intestinal gland cells with few numbers of mitotic figures (dark circles). The narrow lumen of the intestinal gland can also be seen. A concurrent effect in pigs has been reported. EFSA, (2016) reported that higher levels of SM caused mucosal lesions in the stomach and the first part of the large intestine. Alimohammadi et al. (2021) reported that SM increased the early and late apoptotic cell percentage and exposure to SM food additive increased the rate of fragmented nuclei which also indicated apoptosis induction in human fetal foreskin fibroblasts cells.

## Conclusion

This study has shown the harmful effects of sub-chronic exposure to SM particularly, it caused damage to the small intestine. Therefore, the usage of SM as a food preservative should be lessened.

## Author contributions

The corresponding author SF and KH conceptualized the main idea of the work along with the acquisition and interpretation of data. AM has done the final evaluation and drafting of the manuscript. All the co-authors conducted the laboratory work and finalized the draft.

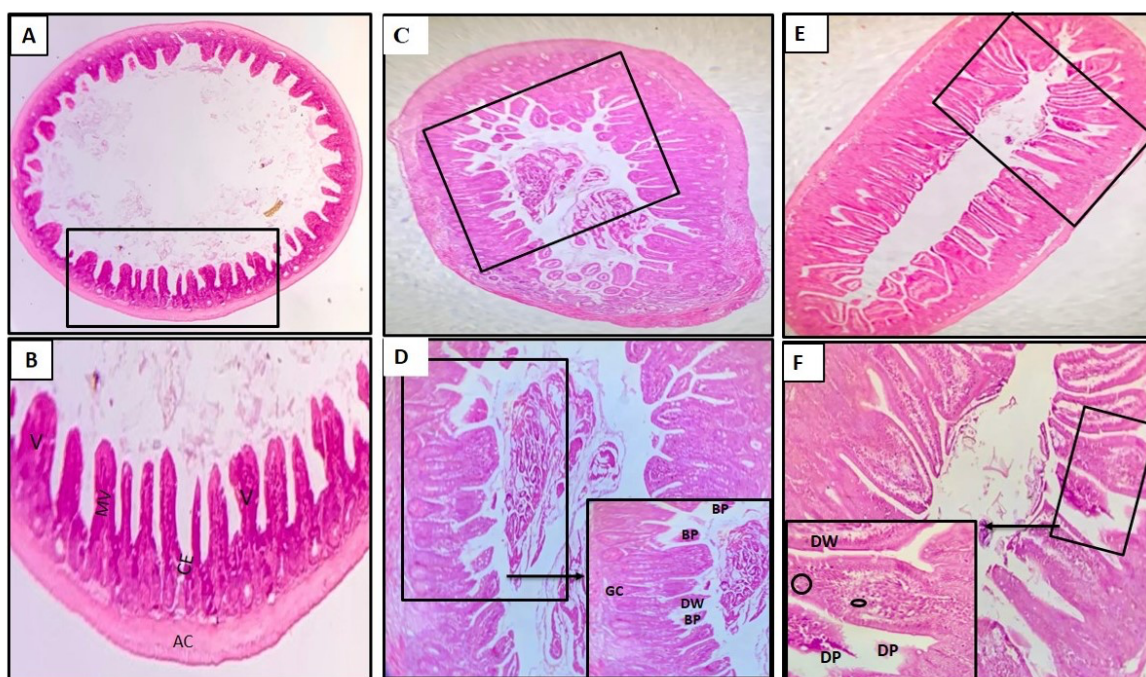


Figure 1: Hematoxylin and Eosin staining of intestinal section of Control (A&B) and experimental mice (C-F). Hematoxylin and Eosin staining of intestinal section of control (A & B) and sub-chronic metabisulfite (2.1 mg/kg) exposed mice. V= Villus, CE= columnar epithelium, DW= Disruption of outer wall, MV= micro villi.

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