



EFFECT OF MONOSODIUM GLUTAMATE ON THE HISTOLOGY OF THE SMALL INTESTINE OF THE ADULTS WISTAR RATS

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Abstract

The objective of the study was to determine the effect of monosodium glutamate (MSG) on the histology of the small intestine of the adult Wistar rats. Twenty (20) adult Wistar rats were used for the study. The animals were randomly selected, weighed and grouped into four (4) according to their body weights (210kg to 280g). Group 1: Control group had five (5) adult Wistar rats administered with 4ml normal saline daily, Group 2: Treated group and had five (5) rats were administered with 20mg/kg body weight of MSG daily, Group 3: Treated group and had five (5) rats and were administered with 40mg/kg body weight of MSG daily and Group 4: treated group and had five (5) rats and were administered with 80mg/kg body weight of MSG daily. The treatment was carried out for the period of four (4) weeks for all the groups. Stock solution of MSG (100mg of MSG dissolved in 50ml of distilled water) was prepared on each day of treatment. The route of administration was by oral means using rubber cap syringe and tube. Haemotoxylin and Eosin (H and E) was used for the staining of the tissue. The results showed a cross section of small intestine of the control group with intact villi and empty lumen. In the treatment group collapsed villi into the intestinal lumen and distorted intestinal epithelium was observed. In the higher dose group ssticken of collapsed villi within the intestinal lumen and more distorted intestinal epithelium was noticed. In conclusion, the MSG was observed to cause necrosis of the epithelia of the villi, sloughing and collapsed of villi into the intestinal lumen. The severity of the effect increased with the increase in dose.

Keywords: Histology, Monosodium Glutamate, Small intestine, Wistar rats

INTRODUCTION

The mammalian intestine is characterized with single layer of epithelial cells lining its lumen (Wright and Alison, 1984). The epithelial lining are renewed every four to five days, this high level of cell proliferation is required to maintain normal homeostasis (Van der Flier and Clevers, 2009). In other context, growth factors are only of the number of signaling pathways and hormones require for the regulation of cellular proliferation. When proliferation is activated by these signals, crypt-residing



intestinal induces stem cells differentiate into specialized epithelial cell types, which including enterocytes, goblet cells, paneth cells, and enterocytes, for the maintenance of normal intestinal tissue integrity (Bjerknes and Cheng,, 2005).

Glutamate has been reported as one of the amino acids commonly found in nature and is the main component of many proteins and peptides of most tissues. It is produced in the body and plays a key role in the metabolic pathway. Many protein-rich food products contain glutamate in either free or bound state (IFIC, 1994). Monosodium glutamate (MSG) is commonly used as a flavor enhancer (Ikeda, 1997; FDA, 1995). However, the MSG is abused among the people especially in West Africa. The normal amount of 5g/l of soup or sausage is mostly exceeded beyond expectation. In Nigeria many food vendors located in motor garages, institutions, on road sides, and in markets are misusing MSG. Many put 10-20g/l of MSG in their foods, (Martins, 2004). There is introduction of many brands of MSG in Nigerian markets with many names such as Ajino motto, Vedan, Kings, Sandoz, Kawiski etc and more than 20 brands can be found nowadays in shops in Nigeria (Oska, 2005).

There is limited knowledge about the mentioned toxic effects of MSG amongst Nigerians especially amongst the common man; they prepare to use of MSG as seasoning in their food, possibly due to cheapness and affordability of MSG. Many use MSG in place of meat as they cannot afford the meat (Martins, 2004). Thus this study determined the effect of monosodium glutamate on the histology of the small intestine of the adult Wistar rats.

MATERIALS AND METHODS

Acclimatization of experimental Wistar rats

The animals were kept in Animal House of the Human Anatomy Department, Ahmadu Bello University, Zaria under standard environmental conditions $\pm 25^{\circ}\text{C}$ relative humidity of 60%, 12hours-12hours light and dark cycle were maintained. The animals were caged in Perspex cages with stainless steel floor and top to facilitate cross ventilation measuring 45x288x12cm. Clean tap water was provided in plastic bottles with stainless steel nozzle while the feed was provided in plastic bowls.

Grouping of the Wistar rats

Twenty (20) adult Wistar rats were used for the study. The animals were randomly selected, weighed and grouped into four (4) according to their body weights (210g to 280g). Group 1: Control group has five (5) adult Wistar rats administered with 4ml normal saline daily, Group 2: Treated group and has five (5) rats were administered with 2mg/ kg body weight of MSG daily, Group 3: Treated group and has five (5) rats and were administered with 4mg/ kg body weight of MSG daily and Group 4: treated group and has five (5) rats and were administered with 8mg/ kg body weight of MSG daily.



Weighing of the Wistar rats

The animals were weighed before the commencement of the treatment and weekly during the treatment period using digital electronic weighing balance. The weight of individual animal was recorded.

Administration of monosodium glutamate (MSG)

The treatment was carried out for the period of four (4) weeks for all the groups. Stock solution of MSG (10mg/ml) was prepared on each day of treatment. The route of administration was by oral means using rubber cap syringe and tube.

Sacrifice of the Wistar rats

The animals were sacrificed under chloroform used for anaesthesia and the required organs were removed and fixed in the sample bottles as soon as possible.

Preparation of tissues for microscopic studies

The following materials were used for this purpose: airtight sample bottles containing the fixative (10% buffered formalin) for each of the organs of each rat, absolute alcohol and 95%, 70% alcohol for clearing of the tissue. Paraffin wax was used for the infiltration and embedding of the tissues, egg albumin, glass slides and Haemotoxylin and Eosin (H and E) was used for the staining of the tissue.

RESULTS

Plate I showed a cross section of cross section of small intestine of the control group with intact villi and empty lumen. All the intestinal layers were intact and the muscular components were normal. The result of the treated groups showed necrosis and collapse of the villi into the intestinal lumen among all the treated groups (Plates II -IV). Plate II shows cross section of the collapsed villi into the intestinal lumen and distorted intestinal epithelium. From Plate III villi collapsed into the intestinal lumen and distorted intestinal epithelium was evident. For Plate IV the higher dose group showed sticken of collapsed villi within the intestinal lumen and more distorted intestinal epithelium

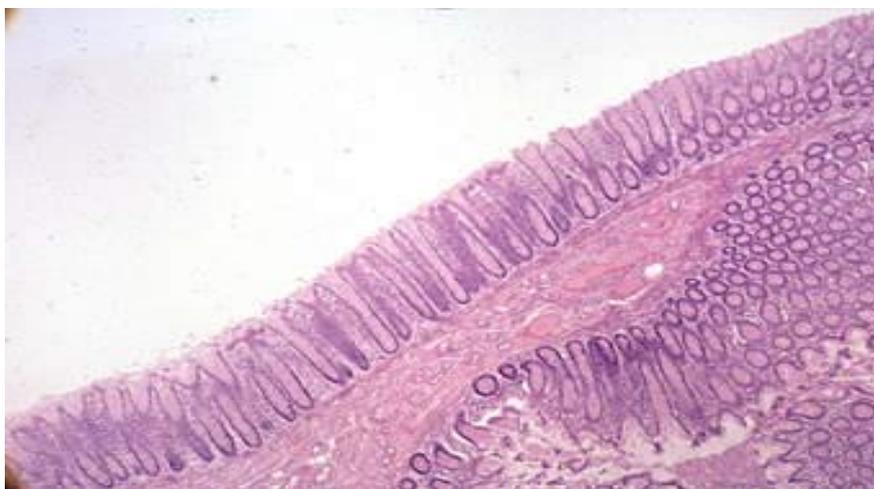


PLATE 1: a cross section of small intestine treated with normal saline showing normal histology. Control group [mg x400, H & E stain]

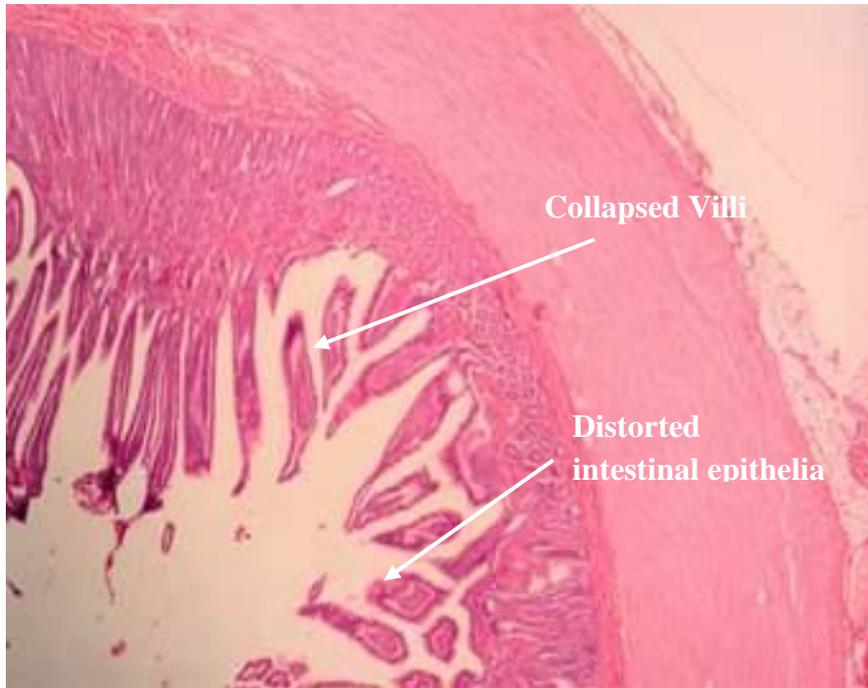


PLATE II: a cross section of the small intestine treated with MSG 20mg/kg body weight [mg x400, H & E stain]

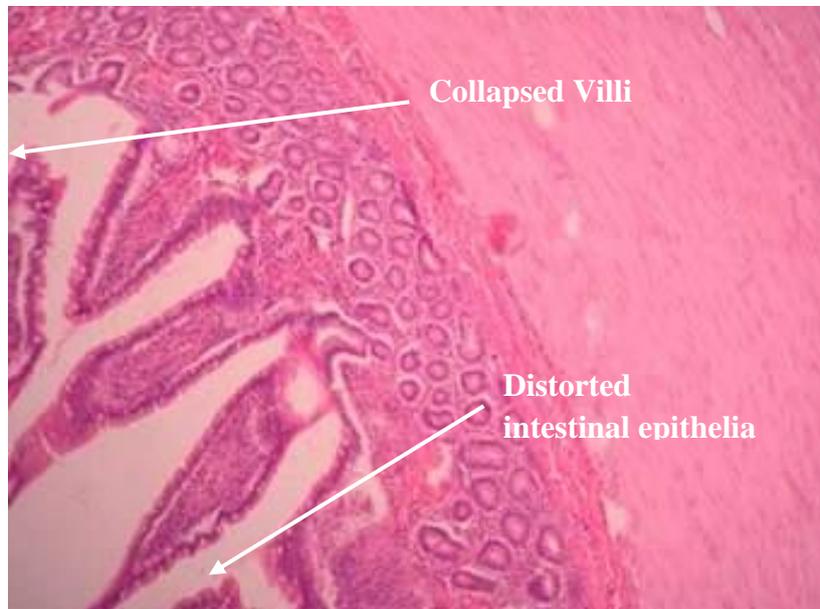


Plate III: a cross section of the small intestine treated with MSG 40mg/kg body weight. [mg x400, H&E stain]

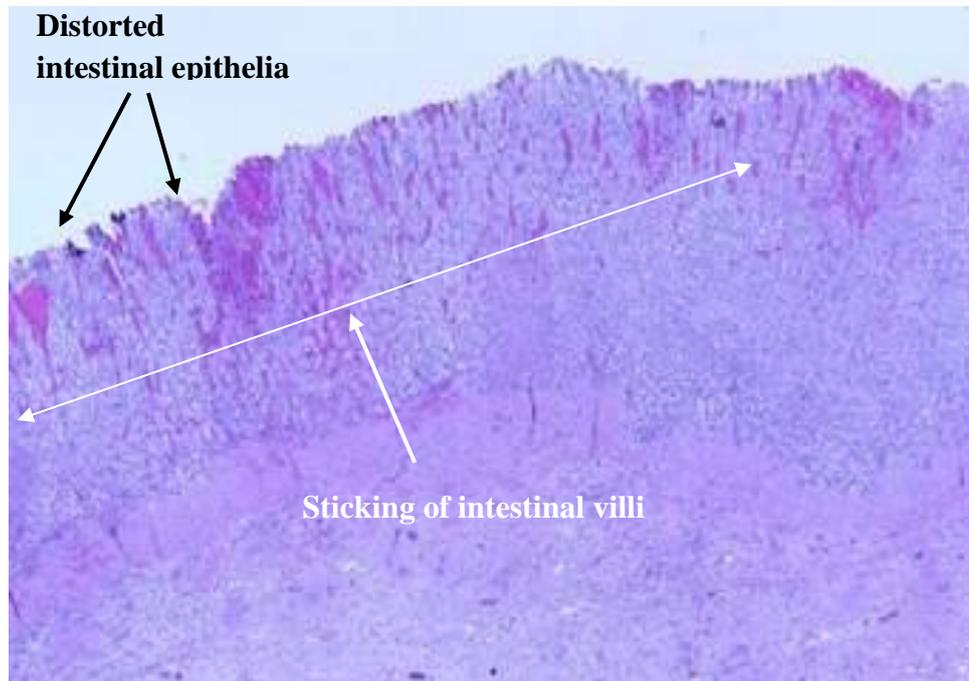


PLATE IV: a cross section of the small intestine treated with MSG 80mg/kg body weight. [mg x400, H &E stain]

DISCUSSION

The severity of the lesion of the small intestine increases with dosage. This means that lesions were more in the group that received the highest dosage. This also suggests that MSG has effects like necrosis, sloughing and collapse of the intestinal villi, on the small intestine of the adult wistar rats. If these lesions were in human it may lead to conditions like bacterial over growth, which is characterized by chronic diarrhea, abdominal pain, mal-absorption and weight loss (Sandler, 2002). Studies in healthy adults have demonstrated that most of the absorbed glutamine is metabolized within the intestine. One-fourth of the plasma glutamine is taken up by the small intestine when it passes the organ, hence is a major substrate utilized by intestinal cells (Hankard *et al.*, 1995; Kim and Kim, 2017). This intimate function of small intestine with respect to glutamate may result in higher rate of absorption of MSG in the small intestine, hence the effect of the MSG on the small intestine observed in this study.

It was recently highlighted that food products that contain MSG exhibit some level the side effects (Ghosh, 2017). It was also suggested that the MSG acted as toxins to the cell of the small intestine. The process of cellular necrosis involves disruption of membrane's structural and functional. In cellular necrosis, the rate of progression depends on the severity of the environmental insults (Eweka and Om'Iniabo, 2007). This may explain the dose dependant effect of the MSG in the intestine of the wistar rats. However, molecular level analyses and chronic effects may revealed more detailed information regarding the effects of MSG on the intestinal mucosa and also may explain the possible mechanism through which the MSG elicit it action.



CONCLUSION

In conclusion, the MSG was observed to cause necrosis of the epithelia of the villi, sloughing and collapsed of villi into the intestinal lumen. The severity of the effect increased with the increase in dose.

RECOMMENDATION

There is need to educate restaurants and food processing companies about the toxic effects of monosodium glutamate on the small intestine. The government should encourage the monosodium glutamate producing companies to provide the specific non-toxic dosage of MSG to its consumers. In other hands people should minimize the use of MSG as food additive due to the fact that it causes the above mentioned effects.

Conflict of Interest: There is no existence of conflict of interest financially or otherwise



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