EVALUATION OF TOXIC EFFECT OF MONOSODIUM GLUTAMATE ON THE HISTOLOGY OF THE LIVER 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 liver 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) groups 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 had five (5) rats that were administered with 2mg/ kg body weight of MSG daily, Group 3: Treated group and had five (5) rats and were administered with 4mg/ kg body weight of MSG daily, Group 4: treated group and had five (5) rats and were administered with 8mg/ 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 needle. Haemotoxylin and Eosin (H and E) was used for the staining of the tissue. The results showed a cross section of liver treated with normal saline showing normal histology. The liver treated with MSG 20mg/ kg body weight showed some necrosis of hepatocytes, distorted hepatic cords and dilated sinusoids. The necrosis of hepatocytes, distorted hepatic cords and dilated sinusoids was more severe with increase of dose of MSG. In conclusion, it was observed that MSG has some effects on the histology of liver of the adult Wistar rats. The effects include necrosis, dilatation of sinusoids and distortion of hepatic cords, the severity of the effect increased with increasing dosage of MSG.

Keywords: Liver, Histology, Monosodium Glutamate, Wistar rats
INTRODUCTION

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 key roles in the metabolic pathway. Many protein-rich food products contain glutamate as either in free or bound state of animal (IFIC, 1994). Monosodium glutamate (MSG) is commonly used as a flavor enhancer (Ikeda, 1997; FDA, 1995). At least 20 million people in the developed countries and more than 100 million people world-wide react to MSG with, 30% of the population experiencing some symptoms from the MSG in amounts commonly added to food (FDA, 1995). MSG intolerance is not an allergic reaction but sensitivity to the chemical (Hermanussen and Tresguerres, 2003). In addition to the symptom mentioned above, there are five most common symptoms, heart burn, diarrhea, abdominal cramps, unusual thirst and nausea (Kwok, 1969). In rare cases, symptoms can be prolonged and may lead to death. It has been proven that Asthma can be precipitated by MSG (Little, 2000). MSG was included among the list of carcinogens (WHO, 2004).

Liver is the heaviest gland in the body weighing about 1.5kg (in human). It is dark-red or reddish-brown in fresh condition (Junqueira, 2003). In addition to the digested and stored food in the liver, the portal blood also carries to the liver various toxic materials which then, the liver detoxicate and or excretes them. It is susceptible to damage from absorbed toxic materials. It performs several functions. It is important in the maintenance of blood glucose concentration. Parenchyma cells take up blood glucose and store it as glycogen. Glycogen is also formed from other compound such as lactic and pyruvic acids. The liver is vulnerable to a variety of metabolic toxic microbial circulation and neoplastic insults. The dominant primary diseases of the liver are viral hepatitis and alcoholic liver disease (Jungermann and Kietzmann, 1996; Saexna et al., 1999; Ganem and Prince, 2004).

Monosodium glutamate 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 local restaurants (bukas) 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 in Nigeria especially amongst the common man; therefore they prepare the use of MSG as seasoning in their food. MSG is cheap and affordable by the common man. Many use MSG in place of meat as they cannot afford the meat (Martins, 2004). The objective of the study was to determine the effect of Monosodium Glutamate on the histology of the liver of the adults wistar rats.
MATERIALS AND METHODS

Animal acclimatization
The animals were kept in Animal House of the Human Anatomy Department, Ahmadu Bello University, Zaria under standard environmental conditions ±25°C, relative humidity of 60%, 12-hours light and 12-hours dark cycle were maintained. The animals were caged in Perspex cages with stainless steel floor and top to facilitate cross ventilation measuring 45x28x12cm. Clean tap water was provided in plastic bottles with stainless steel nozzle while the feed was provided in plastic bowls.

Animal grouping
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 animals
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 a 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 needle.

Sacrifice of the animals
The animals were sacrificed under chloroform used for anaesthesia and the required organs were removed and fixed immediately in the sample bottles containing the fixatives.

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 shows a cross section of liver treated with normal saline showing normal histology. The hepatocyte, hepatic cord and sinusoid were observed to be intact. Plate II shows cross section of the liver treated with MSG 20mg/ kg body weight. It was observed that the MSG induced some necrosis of hepatocytes, distorted hepatic cords and dilated sinusoids. In Plate III necrosis of hepatocytes, distorted hepatic cords and dilated sinusoids was more pronounced. For Plate IV the necrosis of hepatocytes, bleeding in some area and distorted hepatic cords and necrosis was observed to be more severe in this group.

PLATE I: a cross section of liver treated with normal saline showing normal histology. Control group [mg x400, H & E stain]
PLATE II: a cross section of the liver treated with MSG 20mg/kg body weight [mg x250, H&E stain]

Plate III: a cross section of the liver treated with MSG 40mg/kg body weight. [mg x250, H&E stain]
DISCUSSION
The liver cells and interstitium of the rats in the control group showed normal histology. All the cellular components were normal. As for the treated group rats, there was congestion in the vessels and there were focal areas of necrosis (localized) of the hepatocytes. The sinusoids were dilated and there was mononuclear cellular infiltration and distorted hepatic cords. The lesions increased with the dosage of MSG, and were more severe among the group that received the highest dosage that was 8mg/kg body weight of MSG. If this severity were to occur among humans, it will lead to a massive damage to the hepatocytes and consequently hepatic failure (Ganem and Prince, 2004, Gerber and Sulan, 1987). This suggests that MSG has effects like dilatation and distortion of hepatic sinusoids and cords respectively and necrosis of the hepatocytes.

It was suggested that Monosodium Glutamate (MSG) at low doses is capable of producing alterations in the body weight and liver functions (Tawfik. and Al-Badr, 2012; Oladipo et al., 2016). This was manifested in the histology of the liver observed in the present study. These alterations appear in the liver may be due involvement of liver in detoxification of foreign compounds in the body (Johnson, 1995; Tawfik and Al-Badr, 2012). To support the present finding increase in the relative liver weight compared to control was also documented in previous study (Maha et al., 2017). This was attributed to increase in oxidative damages that could lead to inflammation of liver tissues (Park et al., 2000 and Onyema et al., 2006). It also noted that significant increase in the liver weight of the rats could explain an increase in activity of inflammatory agents that resulted to inflammation of liver tissues (Park et al., 2000). However, there is need to expand this work to molecular level and to a longer period of
MSG treatment under an electron microscope (if available). There is need to educate restaurants and food processing companies about the toxic effects of monosodium glutamate on the liver. It was recently documented that all the side effects of MSG indicate that it should be avoid and/or reduce the consumption of food products that contain MSG (Ghosh, 2017).

CONCLUSION
In conclusion, it was observed that MSG has some effects on the histology of liver of the adult Wintar rats. The same effects include necrosis, dilatation of sinusoids and distortion of hepatic cords, the severity of the effect increased with increasing dosage of MSG.

RECOMMENDATION
There is also need by the government to encourage the monosodium glutamate producing companies to provide the specific non-toxic dosage of MSG to its consumers. People should minimize or stop the use of MSG as food additive due to the fact that it causes the above mentioned effects.

Conflict of Interest: None declared by the authors
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