

# Cytotoxic effect of monosodium glutamate (MSG) on hepatocytes of *Mus musculus*.

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## ABSTRACT

Monosodium glutamate (MSG) is important flavour enhancer in modern era especially used in Chinese items. MSG is chemically sodium salt of glutamic acid. Investigation aimed to find out the effect of MSG on hepatic cells of *Mus musculus*. Experimental animals were divided into control group (Group A), 3 weeks dose group (Group B), 6 weeks dose group (Group C) and 9 weeks dose group (Group D). Control group animals were feed with normal feed and water while experimental groups B, C and D were treated with 80 mg/100 gm of body weight dose of MSG. Animals from all groups were sacrificed according to CPCSEA guideline and interested liver tissue was taken for histological investigation. Histopathology revealed that there were drastic changes found in cellular architecture of liver tissues leading to different physiological symptoms. The alterations were discussed in relation to hepato-toxicity and relevant metabolism.

**Key words** – Monosodium glutamate, glutamic acid, hepatotoxicity, *Mus musculus*.

## INTRODUCTION

Monosodium glutamate (MSG) commonly known as Ajinomotto which is widely used as food additive in especially in Chinese food content. It is sodium salt of non essential amino acid- glutamic acid. MSG contains 78 % of glutamic acid, 22% of sodium and water (Samuels, 1999). Glutamate is one of the most common amino acid and main component of many proteins of most tissues. MSG is excitotoxin, get easily absorbed in gastrointestinal tract. Earlier studies reported that, MSG causes Chinese restaurant syndrome (CRS), neurotoxic effects in brain, obesity and various metabolic effects. Chinese restaurant syndrome (CRS) showed symptoms like- chest pain, headache, skin flushing, facial swelling, sweating, etc. MSG have taste stimulation and improves appetite, reports indicates it is toxic to human and experimental animals (Andrew, 2010). MSG diet influenced both hepatic and adipose tissues in both male and female (Ramos et al; 2011).

Previous experiments showed brain lesions and biochemical alterations resulting into obesity as a major health issue worldwide (Olney 1969). In addition to that, higher concentration of MSG also was allergic to cause asthma, urticaria, atopic dermatitis, neuropathy and abdominal discomfort (Geha et al., 2000). The potential link between MSG and obesity includes the MSG effect on energy balance by increasing palatability of food and by disrupting the hypothalamic signaling cascade of leptin action (He et al. 2011). Thomas et. al. (2009) reported that, hyperlipidaemia with significantly elevated levels of serum triacylglycerol and cholesterol reported in MSG treated rats.

Liver is the largest digestive gland in mammals. It play very important role in various metabolic activities in mammalian body. It plays vital role in detoxification, deamination, transamination, conversion of ammonia into urea, biosynthesis and release of non-essential amino acids, storage of glycogen, conversion of carbohydrates and proteins into lipids, storage of vitamins A, D and B 12. So because of wide range of functioning of liver and its role in metabolism the above problem is selected for investigation. Present investigation is to understand the cytotoxic effect of MSG on different cells of liver tissue and its impact on metabolic events as a pathological symptoms.

## MATERIAL METHODS

For present study, male mice (*Mus musculus*) was used as experimental animal. Animals were reared and breed in animal house of Department of Zoology, Shivaji University, Kolhapur. The investigation was carried out with permission of authorized CPCSEA approval for animal experiment. Before conducting the study, experimental mice were kept in the departmental animal house for one week in normal environment (24-28°C) with normal diet and water. Animals were breed and selected for experimental procedure. Animals were grouped as table given below-

Group	A	B	C	D
Animal	4	4	4	4
Dose	Control	80mg/100 gm of body weight	80mg/100 gm of body weight	80mg/100 gm of body weight
Days	-	3 weeks	6weeks	9weeks

After the completion of exposure period with respective dose animals were sacrificed for histological study as per CPCSEA guideline. After scarification of animal liver tissue was subjected to histological study by applying standard micro- technique procedure. For histological analysis Haematoxylene and Eosin technique was used. The photographs were compared for pathological differentiation and conclusion.

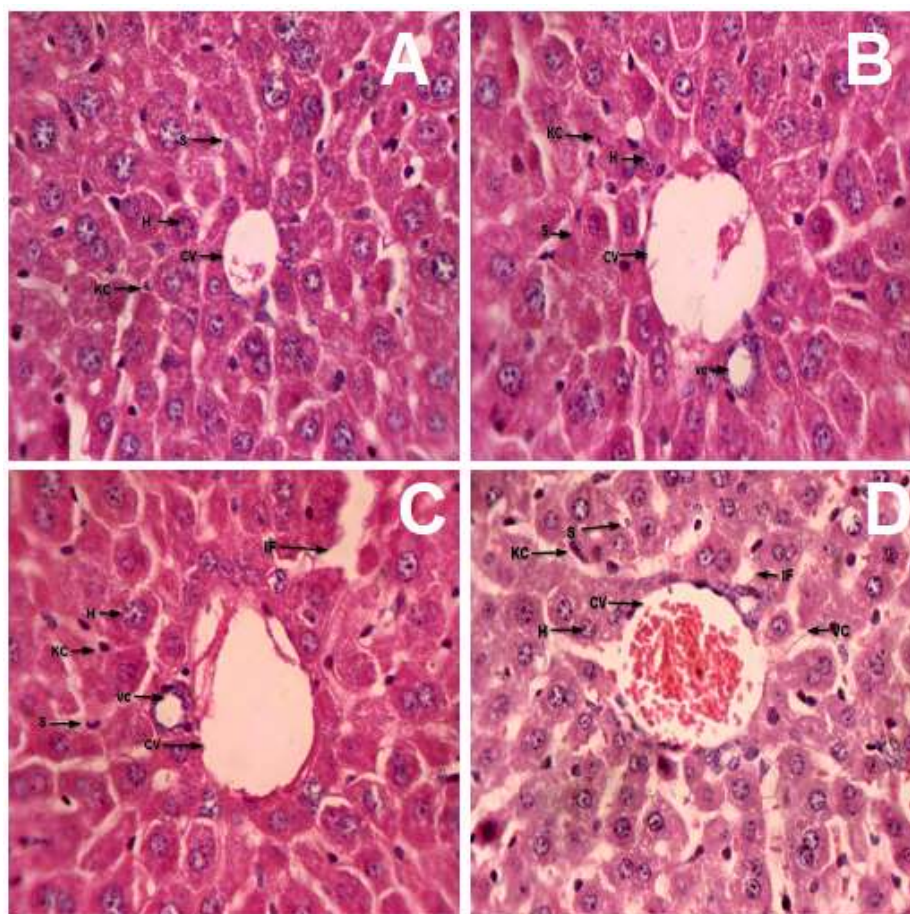
## RESULTS & DISCUSSION

Previous studies were reported that MSG content diet has influenced both hepatic and adipose tissue in both adult mice (Roman- Ramos et al. 2011). Higher adipocyte lipid content, cell diameter, surface area and volume in spite of lower body weight with the results in arrested growth and obesity after MSG administration as compared to control rats which have been found (Dolnikoff et al., 2001). The doses and administration of MSG against rodents in other studies were designed for obesity; metabolism and hepatocyte pathology investigation (Eweka et al., 2011). These were found more similar to consumption of MSG in human being which has suffered from neuronal deformities.

In the present investigation we found that, control group of animals showed normal hepatic cells which maintained their histological architecture. Hepatic lobules were regularly arranged, hepatocytes enclosing sinusoids network with central vein was located at the centre of the lobule. Hepatocytes in control sections were typically polygonal in shape showing prominent oval nuclei. Blood sinusoids in control sections were lined with Kupffer cells and endothelial cells. In all normal architecture was found in control animals showing normal physiological functions and without any pathological symptoms in the behaviour aspects.

In comparison to the normal, we found stepwise increased pathological observations in the experimental groups as in 3 weeks, 6 weeks and 9 weeks.

In the experimental, 3 weeks treated group of animals induced with MSG, liver section showed a mild disturbances in their histological architecture. Liver cells were slightly enlarged with congested central vein and hypertrophy of endothelial lining. Tissue sections showed polygonal hepatocytes with oval nuclei arranged at the periphery with numerous vacuolations was observed under microscope.



**Figure1:** A- Normal histological structure of liver male mice showing normal liver architecture with normally arranged hepatocytes, central vein, Kuffer cells and blood sinusoids (H/E, X400). B- Liver section of mice administrated with MSG (monosodium glutamate) for 3 weeks with mild disturbances in arrangement of hepatocytes, enlarge central vein and numerous vacuolations (H/E, X400). C- Liver section of mice administrated with MSG (monosodium glutamate) for 6 weeks with irregular network of hepatocytic cells, enlargement of central vein, infiltrations of inflammations and degenerative changes (H/E, X400). D- Liver section of mice administrated with MSG (monosodium glutamate) for 9 weeks with severe disturbances in network of hepatocytes, degeneration of hepatocytes, enlarged central vein, numerous vacuolation, infiltration of inflammatory and blood cells in central vein (H/E, X400).

In 6 weeks treated animals, after induction of MSG, liver sections showed increased pathology of endothelial lining. The polygonal shapes of peripheral hepatocytes were increased. Circulatory network was found to be irregular. The sectional view showed some scattered cells at the periphery and hypertrophy of marginal cells including ruptured wall. In this section the vacuolations commonly observed at regular intervals indicating higher inflamed hepatocytes.

For the third group of animals induced with high dose after 9 weeks found with severe pathogenicity in hepatic cells, the cells consists of maximum degeneration of hepatocytes, nuclei pyknosis and congested blood vessels were commonly observed. Similar observations

were reported by Bhattacharya, et.al. (2011). in 9 weeks treated group we found marked disturbances in hepatocytic cords and liver parenchyma. Over all the sections showed major disturbances in total hepatic architecture with numerous luminal spaces along with degenerated cellular content. Animals were showed more pathological indicating hypersensitivity to the dose of MSG.

Animals after the 9 weeks of intoxication showed metabolic disturbances and with more changes in their behaviour aspects also. In conclusion we found that, as intake of MSG increases with increased exposure period, animals became more pathogenic and symptomatic to clinical disturbances.

## CONCLUSION

*Mus musculus* is found to be best experimental model against intoxication study of MSG. In the experiment as the dose of MSG increased as per the increased exposure period the targeted hepatic cells became more pathogenic. The pathological observations showed that the MSG can interfere the metabolism of hepatic cells. At the higher consumption of MSG behaviour changes were more prominent showing neuronal disturbances with muscular abnormalities. Higher exposure of MSG has pathological evidences if bio- concentrated in the animal cells.

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