

# Histological Studies Of The Effects Of Monosodium Glutamate On The Liver Of Adult Wistar Rats

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## Abstract

Histological effects of Monosodium glutamate (MSG) commonly used as food additive on the liver of adult Wistar rats were carefully studied. The rats of both sexes (n=24), average weight of 185g were randomly assigned into two treatments (n=16) and control (n=8) groups. The rats in the treatment groups received 3g and 6g of MSG thoroughly mixed with their feeds for fourteen days, while the control rats received equal amounts of feeds without MSG added. The rats were fed with growers' mash purchased from Edo Feeds and Flour Mill Ltd, Ewu, Edo State and were given water liberally. The rats were sacrificed on day fifteen of the experiment. The liver was carefully dissected out and quickly fixed in 10% formal saline for routine histological study after H&E method.

The histological findings after H&E methods indicated that the treated sections of the liver showed evidence of dilatations of the central veins, which contained lysed red blood cells and cyto-architectural distortions of the hepatocytes, centrilobular hemorrhagic necrosis, atrophic and degenerative changes with the group that received 6g of MSG more severe. These findings indicate that MSG consumption may have some deleterious effects on the liver of adult Wistar rats at higher doses and by extension may affect the functions of the liver. It is recommended that further studies aimed at corroborating these findings be carried out.

## INTRODUCTION

Most food additives act either as preservatives or enhancers of palatability. One of such food additive is monosodium glutamate (MSG) and it is sold in most open markets and stores in Nigeria as "Ajinomoto" marketed by West African Seasoning Company Limited; as "Vedan" or "White Maggi" marketed by Mac and Mei (Nig) Limited. Various environmental chemicals, industrial pollutants and food additives have been implicated as causing harmful effects<sup>1</sup>.

The safety of MSG's usage has generated much controversy locally and globally<sup>2</sup>. In Nigeria, most communities and individuals often use MSG as a bleaching agent for the removal of stains from clothes. There is a growing apprehension that its excellent bleaching properties could be harmful or injurious to the stomach mucosa, or worse still inducing terminal diseases in consumers when ingested as a flavor enhancer in food. Despite evidence of negative consumer response to MSG, reputable international organizations and nutritionist have continued to endorse MSG, reiterating that it has no adverse reactions in humans. Notably of such is the Directorate and Regulatory Affairs of Food and Drug Administration and Control (FDA&C) in

Nigeria, now NAFDAC has also expressed the view that MSG is not injurious to health<sup>3</sup>.

MSG improves the palatability of meals and thus influences the appetite centre positively with it resultant increase in body weight<sup>4</sup>. Though MSG improves taste stimulation and enhances appetite, reports indicate that it is toxic to human and experimental animals<sup>5</sup>. MSG has a toxic effect on the testis by causing a significant oligozoospermia and increase abnormal sperm morphology in a dose-dependent fashion in male Wistar rats<sup>6</sup>. It has been implicated in male infertility by causing testicular hemorrhage, degeneration and alteration of sperm cell population and morphology<sup>7</sup>. It has been reported that MSG has neurotoxic effects resulting in brain cell damage<sup>8</sup>, retinal degeneration, endocrine disorder and some pathological conditions such as addiction, stroke, epilepsy, brain trauma, neuropathic pain, schizophrenia, anxiety, depression, Parkinson's disease, Alzheimer's disease, Huntington's disease, and amyotrophic lateral sclerosis<sup>9</sup>.

The liver is the largest glandular organ of the body, weighing between 1.4-1.6kg. It lies below the diaphragm in

the thoracic region of the abdomen. It plays a major role in metabolism and has a number of functions in the body, including glycogen storage, plasma protein synthesis, production of bile; an alkaline compound which aids in digestion, and detoxification of most substances<sup>10</sup>. Since the liver is involved in the performance of these varied functions it may be susceptible to injury particularly in situation of toxicity. It would therefore be worthwhile to examine the effects of Monosodium glutamate (MSG) on the liver of adult Wistar rat.

### **MATERIALS AND METHODS**

**ANIMALS:** Twenty four (24) adult Wistar rats of both sexes with average weight of 185g were randomly assigned into three groups A, B and C of (n=8) in each group. Groups A and B of (n=16) serves as treatments groups while Group C (n=8) is the control. The rats were obtained and maintained in the Animal Holdings of the Department of Anatomy, School of Basic Medical Sciences, University of Benin, Benin city, Nigeria. They were fed with growers' mash

obtained from Edo feed and flour mill limited, Ewu, Edo state) and given water liberally. The rats gained maximum acclimatization before actual commencement of the experiment. The Monosodium glutamate (3g/ sachet containing 99+% of MSG) was obtained from Kersmond grocery stores, Uselu, Benin City.

**MONOSODIUM GLUTAMATE ADMINISTRATION:** The rats in the treatment groups (A and B) were given 3g and 6g of MSG, thoroughly mixed with the growers' mash, respectively. The control © group received equal amount of feeds (growers' mash) without MSG added for fourteen days. The rats were sacrificed on the fifteenth day of the experiment. The liver was quickly dissected out and fixed in 10% formal saline for routine histological techniques. The 3g and 6g MSG doses were chosen and extrapolated in this experiment based on the indiscriminate use here in Nigeria due to its palatability. The two doses were thoroughly mixed with fixed amount of feeds (550g) in each group, daily.

**HISTOLOGICAL STUDY:** The tissue were dehydrated in an ascending grade of alcohol (ethanol), cleared in xylene and embedded in paraffin wax. Serial sections of 6 microns thick were obtained using a rotatory microtome. The deparaffinized sections were stained routinely with haematoxyline and eosin. Photomicrographs of the desired sections were made for further observations.

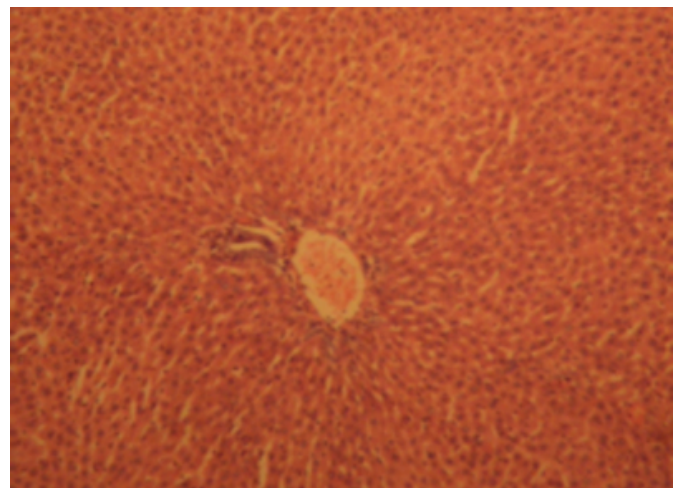
### **RESULTS**

The control sections of the liver showed normal histological features with the hepatic lobules showing irregular hexagonal boundary defined by portal tract and sparse collagenous tissues. The hepatic portal veins, bile ductules and hepatic artery within the portal tract were all visible. (Figure1).

The treatment sections of the liver showed some histological changes that were at variance with those obtained in the control. There were evidence of dilatations of the central veins, which contained lysed red blood cells and cyto-architectural distortions of the hepatocytes and centrilobular hemorrhagic necrosis. There were atrophic and degenerative changes with the group that received 6g of MSG more severe (Figure 2 & 3).

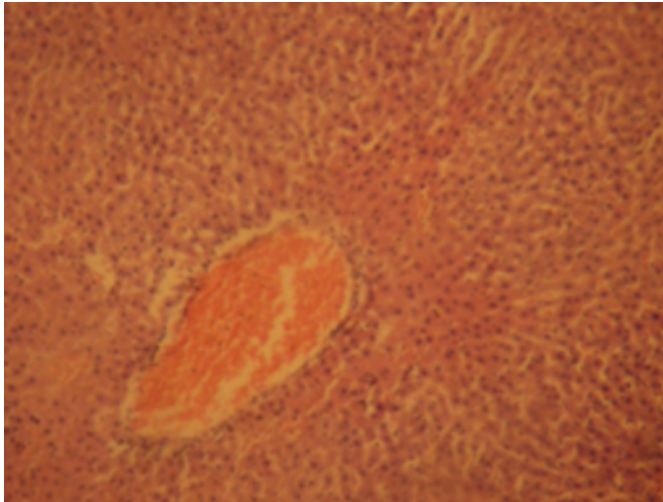
#### **Figure 1**

Figure 1: Control section of the liver (Mag. x400).



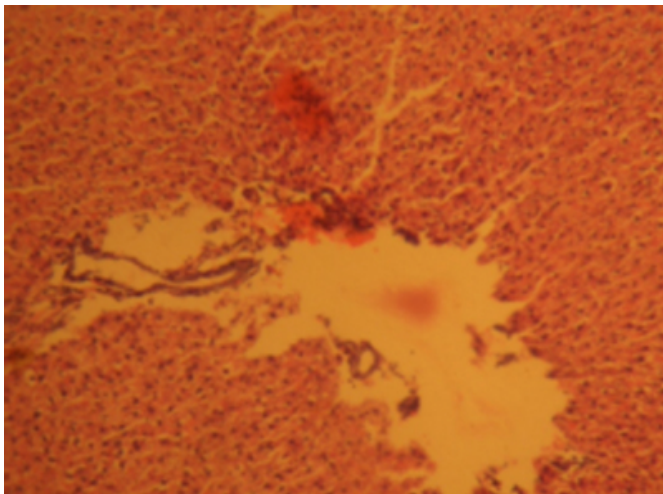
**Figure 2**

Figure 2: Treatment section of the liver, showing dilated central vein with lysed red blood cell. (3g MSG) (Mag.x400)



**Figure 3**

Figure 3: Treatment section of the liver, showing atrophic and degenerative changes around the central vein and hepatocytes (6g MSG) (Mag.x400)



**DISCUSSION**

The results of the haematoxyline and eosin staining (H & E) reactions revealed that with increasing dose of monosodium glutamate consumption there was varying degrees of dilatations of the central vein of the liver which contained lysed red blood cells in the treatment group compared to the control sections of the liver. The necrosis observed is in consonance with the findings recorded in the work carried out by Eweka and Om'Iniaboh's, where it was noted that MSG had a destructive effect on Brunner's gland of the duodenum and the small intestinal mucosa of adult Wistar rats<sub>11</sub>.

The result of this experiment suggests that the distortion of the cyto-architecture of the liver could be associated with functional changes that may be detrimental to the health of the rats. The proliferating cells of the liver, which produce red and white blood cells, are normally found between the hepatic cells and the walls of the vessels<sub>12</sub>. As a result of the distortion and dilatation of the hepatocytes and their central vein, the haemopoietic function of the liver may have been highly affected as a result of probable toxic effect of MSG.

Cellular degeneration has been reported to result in cell death, which is of two types, namely apoptotic and necrotic cell death. These two types differ morphologically and biochemically<sub>13</sub>. Pathological or accidental cell death is regarded as necrotic and could result from extrinsic insults to the cell such as osmotic, thermal, toxic and traumatic effects<sub>14</sub>. Cell death in response to toxins occurs as a controlled event involving a genetic programme in which caspase enzymes are activated<sub>15</sub>.

As the hepatocytes swells as seen in this study the activities of cellular transporters is approximately modified by up or down regulations as earlier reported in the case of hyponatremia or hypernatremia<sub>16</sub>. Ischaemic or pharmacologic disruption of cellular transporters can cause swelling of parenchyma of the liver cells. The disruption caused by MSG is a cardinal feature of the results of this experiment. Though there are many different causes of cell swelling including drug poisoning, water intoxication, hypoxia from asphyxia and acute hyponatremia<sub>16</sub>. MSG may have acted as toxins to the hepatocytes, affecting their cellular integrity and causing defect in membrane permeability and cell volume homeostasis.

The cellular hypertrophy observed in this experiment may have been caused by the cytotoxic effect of MSG on the liver. This obviously will affect the normal detoxification processes and other functions of the liver.

**CONCLUSION AND RECOMMENDATION**

The results obtained in this study revealed that monosodium glutamate consumption could affect the histology of the liver. The hepatocytes of the treated sections of the liver showed some degenerative changes, and cellular hypertrophy. With this result it is probable that the functions of the liver as a major metabolic organ may be adversely affected. It is recommended that further studies be carried out to corroborate these findings.

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