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Research Article

The Effect of Monosodium Glutamate (MSG) on the Gross Weight of the Heart of Albino Rats

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Abstract: Monosodium Glutamate (MSG) is consumed as food additive around the world, studies has revealed some deleterious effect of MSG on different body organs and tissues. This work was undertaken to determine the effect of MSG on the gross weight of albino rats. A total of 30 male rats were at random divided into five groups (A-E) of six rats each. Group A served as control and received normal saline, while rats in group B were administered 4mg/kg body weight of MSG for 28days, rats in group C received 8m/kg body weight of MSG for 14days, group D rats were administered 8mg/kg body weight of MSG for 28days. Rats in group E received 8mg/kg body weight of MSG for 28days and allowed to stay for another 28days post treatment to observe for reversibility, persistence or delayed occurrence of any effect. At the end of the experimental period, each animal was sacrificed and the heart was carefully removed and weighed. Administration of MSG to rats showed a significant increase in heart weight when compared with those in the control group. Withdrawal of MSG for 28days showed some degree of recovery by a reduction in weight of the heart. The findings suggest that the gross weight of the heart can significantly be increase with continuous and/or increased use of MSG.

Keywords: Monosodium Glutamate, gross weight, albino rats

INTRODUCTION

Monosodium Glutamate (MSG), also known as sodium glutamate is a sodium salt of the naturally occurring non-essential amino acid; found in foods such as dairy products, meat and fish and in many vegetable. MSG is used as a chemical additive by food industries and is commonly marketed as a flavour enhancer [6].

MSG as a food ingredient has been subjected to several health studies/ researches. A report from the Federation of American Society for Experimental Biology (FASEB) compiled in 1995 on behalf of the United States Food and Drugs Administration (FDA) concluded that MSG is safe for most people when "eaten at customary levels".
In 1992, in a symposium held in Lagos Nigeria, organized by the Food and Drug Administration and Control (FDA&C) a representative of West African Seasoning Company Ltd., makers of Ajinomoto made known that Ajinomoto which contain above 95% Monosodium glutamate is an ideal food enhancer that contains adequate iodized salts [9].

In Nigeria, commercial launderers and individuals often use MSG as a bleaching agent for the removal of stains from cloths and other textile materials and this excellent bleaching property of MSG could be harmful to tissues and organ of the body when ingested as a flavor enhancer in food. However, National Agency for Food and Drug Administration and Control (NAFDAC) the Nigeria federal government agency with the responsibility to check and control consumable substances has also expressed the view that MSG is not injurious/harmful to health [14].

Basic to the heart's function is the near-inexhaustible cardiac muscle, the myocardium, composed primarily of a collection of specialized muscle cells called myocytes. In many pathological states, the onset of heart failure is preceded by cardiac hypertrophy; the compensatory response of the myocardium to increased mechanical work. The cardiovascular system maintains arterial pressure and perfusion of vital organs in the presence of excessive hemodynamic burden or disturbance in myocardial contractility by a number of mechanisms [7]. Increased mechanical load causes an increase in the content of sub-cellular components and a consequent increase in the cell size (hypertrophy) which will ultimately results in increase in size and weight of the heart. Increased mechanical work owing to pressure or volume overload increases the rate of protein synthesis, the amount of protein in each cell, the number of sarcomere and mitochondria, the dimension and mass of myocytes, and consequently, the size of the heart [11]. Increase heart mass predicts excess cardiac mortality and morbidity. Indeed, besides predisposing to congenital heart failure (CHF), left ventricular hypertrophy is an independent

risk factor for sudden death. Interestingly, and in contrast to the pathologic hypertrophy, hypertrophy that is induced by regular strenuous exercise (physiologic hypertrophy) seems to be an extension of normal growth and has minimal or no deleterious effect [5].

Non-ischemic heart disease of the heart that lacks the associated coronary artery disease often found in other disease of the heart. It's usually linked to a disease in one or more of the cardiac muscles, causing the heart to pump in an ineffective manner thereby reducing the transport of blood, oxygen and other nutrients throughout the body. One of the more common non-ischemic heart diseases is dilated cardiomyopathy; the left ventricle is weakened to the point where it can no longer pump enough blood or expands so that it may pump an adequate amount of blood. The cause of this abnormal dilatation and weakening of the cardiac muscle is unknown but it can be as a result of an infection, genetics, valvular problems, substance abuse or diabetes [13].

Research has revealed that MSG can cause some adverse effects on different body organs and tissues with manifesting symptoms like swelling of prostate, nausea, vomiting, diarrhea, insomnia, migraine headache, running nose, sneezing [15]. MSG is an exitotoxic which excites the neurons and may cause their death [1]. It was also indicated that high dose and prolonged administration of MSG to adult Wistar rats resulted in disruptions and distortions of the cyto-architecture of the kidney [2]. Eweka and Om'Iniabohs also revealed that with increasing dose of MSG consumption by adult Wistar rats, there was varying degrees of dilatations of the central vein of the liver which contained lysed red blood cells, and dilatation of the hepatocytes of the liver [3]. These finding was in consonance with their earlier findings that MSG had a destructive effect on the Brunner's glands of the duodenum and the small intestinal mucosa of the adult Wistar rat. It has also been establish that MSG may be linked in cases of male infertility as it causes testicular hemorrhage, degeneration and alteration of sperm cell population and morphology [8]. The injurious effect of MSG was further corroborated by the study on male Wistar rat testis, significant oligozoospermia and increase abnormal sperm morphology was observed [10]. Also chronic oral administration of high doses of MSG causes oxidative stress which plays an important role in the development of cardiac dysfunction and injury, these was manifested by significant increase in malondialdehyde, conjugated dienes and significant increase activities of aspatate transaminase, creatine phosphokinase and lactate dehydrogenase in serum[12].

Since MSG has been known to be one of the causes of tissue damage, the study aimed at investigating the effect of long term and high dose of oral administration of MSG on the gross weight of the heart.

MATERIALS AND METHODS

Thirty mature male albino rats weighing 210±10g were used in this study. They were obtained from the Department of Pharmacology, University of Jos, Jos plateau state. The rats were left to acclimatize for two weeks at normal conditions with food and water freely. The MSG used was in the form of Aji-no-motto (Aji-no-motto co. Inc. Tokyo, Japan) obtained from Monday market Maiduguri, Borno state.

Thirty (30) albino rats were divided into five (5) groups (A-E) of six rats each at random and administered orally with aqueous solution of MSG daily. Group A served as the control group and received normal saline. Group B served as the low dose group and received ^{4}mg/kg body weight of MSG for 28days. Group C served as the high dose group and received 8mg/kg body weight of MSG for 14days, while group D served as the high dose group and received 8mg/kg body weight of MSG for 28days and group E served as the high dose group and received 8mg/kg body weight of MSG for 28days and allowed for another 28days post treatment. The aqueous solution of MSG was at the concentration of 80g/litre daily for the periods of fourteen (14) days, and twenty-eight (28) days respectively. The rats from group B were sacrificed after fourteen (14) days of treatment while rats from groups C and D as well as those from the control group were also sacrificed after twenty-eight (28) days of MSG administration. The rats from group E were left untreated for twenty-eight (28) days of post treatment period to allow it to recover from any effect(s) of MSG before being sacrificed. The rats were anaesthetized and the thorax opened using ventro-median incision between the jugular notch and the xyphoid process. The heart was removed and striped off of para-aotic fat and fascia before weighing using Mettler Toledo digital/sensitive weighing balance. The measurements obtained were subjected to statistical analysis; the Analysis of Variance (ANOVA), resident of the InStat3 Graph Pad software for windows 2003 was used.

RESULTS

The physical changes observed in the rats treated with MSG were general body weakness (less active) and diarrhea (watery droppings) with the severity decreasing with time. There was no significant increase in the weight of the heart of rats treated with 4mg/kg body weight of MSG for 28days and those treated with 8mg/kg body weight of MSG for 14days when compared with those in the control group. However, there was a significant ($p<0.05$) increase in the weight of the rats treated with 8mg/kg body weight of MSG for 28days and there was no significant increase in the recovery group (Table 1).

Table1: Effect of oral Administration of MSG on the Weight of the Isolated Heart of Albino Rats.

Experimental Groups	Dose Administered (mg/Kg Body Weight)	Duration Of Experiment (Days)	Weight Of The Heart (g) Mean ± SEM
A	Normal Saline		0.63 ± 0.03
B	4	28	0.68 ± 0.05
C	8	14	0.79 ± 0.01
D	8	28	0.84 ± 0.02 *
E	8	28 +28 days post treatment period	0.71 ± 0.09 [a]

Significant relative to control: * $p<0.05$; [a] 8mg/kg body weight of MSG for 28days with 28days post treatment period.

DISCUSSION

The MSG-treated rats showed physical signs of general body weakness (less active) and diarrhea (watery droppings) during the study and these was reported as signs in MSG sensitive individuals [15].

There was no increase in weight of the heart of rats treated with $4mgkg^{-1}$ body weight of MSG for 28days and 8mg/kg body weight for 14days may be as a result of low dose and short period of exposure respectively, however, the increase in weight of the heart of the rats treated with $8mgkg^{-1}$ body weight of MSG for 28days suggests an enlargement of the heart. Cardiac enlargement is an increase in the size of the heart, enlargement of the heart involves either hypertrophy or dilation. Hypertrophy involves an increase in the thickness of the heart muscle and this usually occurs in only one chamber of the heart (left ventricle). In most cases cardiac enlargement is abnormal and accompanied by additional cardiovascular problems [13].

Hypertrophy of the heart occurs in response to increased stress on the heart the most common causes are related to increased blood pressure in the body and is the most frequent cause of Left Ventricular Hypertrophy (LVH) or Hypertrophy Cardiomyopathy (HCM), other causes include genetics, infection, diabetes as well as substance abuse in which MSG can be describe as one. The extra work of pumping blood against the increased pressure causes the ventricle to thicken over time, the same way skeletal muscle increases in mass in response to weightlifting [4]. Symptoms of HCM includes dyspnea (shortness of breath) which is due to increased stiffness of the left ventricle which impairs filling of the ventricle and leads to elevated pressure in the left ventricle and atrium. Other symptoms include chest pain (angina), palpitation, and fatigue which are also associated with the Chinese Restaurant Syndrome [15].

CONCLUSION

In conclusion, the findings revealed that continuous and increased use of MSG can significantly increase the gross weight of the heart and may be as a result of cardiac muscle hypertrophy.

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