Effect of MSG as a food additive on organo-somatic indicator and sperms abnormalities in adult male mice

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ABSTRACT

Objective: Monosodium glutamate (MSG) is the sodium salt of the non-essential amino acid glutamic acid. It is naturally present in the organs and tissues of the human body, such as in our digestive system, brain, milk, and blood. The aim of this project study was to investigate the effect of MSG that is used as a food additive on organo-somatic index and on sperm abnormalities.

Methods: In the present project, MSG was given orally at a dose of 4 mg/g body weight dissolved in drinking water and given to three groups of male mice for different periods 7, 14, and 21 days beside to control group which treated with drinking water only for 7 days orally. Each group contained five animals to study the organo-somatic indicator and sperm abnormalities assay.

Results: The results show that there were no significant differences between the control group with the treated groups for 14 and 21 days, respectively, in the liver, kidney, and testes. While there was a significant difference between control group compared with the treated group for 7 days in all the organs (liver, kidney, and testes) in organo-somatic index. A significant increase in the weight of the mice was observed after the administration of MSG for 7 days with no change in the liver, kidney and testes. This led to decrease the organo-somatic index. In sperm abnormalities study, the results showed a significant difference, such as an increase in the number of abnormal sperm in treating animals for 1, 2, and 3 weeks compared with the control group. The results showed a different types of sperm abnormalities as headless, tailless, hook less, and abnormal sperm head. There was a statistically significant reduction in the normal sperms of the mice that received MSG for 7, 14, and 21 days compared with the control group.

Conclusion: A significant increase in the weight of the mice was observed after the administration of MSG, and there was a significant reduction in the normal sperms of the mice that received MSG.

INTRODUCTION

Linked to environmental chemicals and industrial pollutants, food additives cause damage being together 1. Many food additives reserve either as preservatives or enhance palatability. Monosodium glutamate (MSG) is one of the food additives, found naturally. It is a glutamic acid, sodium salt of nonessential amino acid and a white crystalline substance 2. MSG was used as a food additive, especially in Asian and West African dishes. It is usually marketed as a flavor enhancer 3. A very large number of foods contain MSG. It is found in chips, salad dressings, fresh fruits, and vegetables that have been sprayed with pesticides, gelatin, cold meats, and in almost food served in every fast food restaurant. In general, MSG has been accepted as a food additive...
and it does not need to average daily consumption or taking the upper limit. It has been reported the average daily dietary exposure to MSG in developed countries to be in the range of 0.3 to 1.0 g/day. Data from the UK are estimated on average in their diet daily from MSG is about 0.6 g/day, with consumers having extreme cases of exposure to more than 2 g/day. The reports indicated that MSG is not toxic to human and experimental animals, although stimulated taste and improve appetite.

MSG can produce symptoms such as numbness, flushing, sweating, dizziness, headache and weakness. As well as to these MSG symptom complex, ingestion of MSG has been claimed to cause or aggravate many conditions, including asthma, urticaria and atopic skin inflammation, irregular ventricular heart rate, neuropathy, and abdominal pain. Research confirmed that MSG has a toxic effect on the testis in male Wister rats, depending on the method of dose by causing a large increase oligozoospermia and abnormal sperm morphology. And it was reported that MSG has toxic effects of nerve leading to brain damage, and conditions such as addiction, stroke, epilepsy, mental brain trauma, pain nerves, schizophrenia, anxiety, depression, Parkinson’s disease, Alzheimer’s disease, Huntington’s disease, and amyotrophic lateral sclerosis.

MATERIALS AND METHODS

Monosodium glutamate

MSG had brought from the market of Baghdad city, as a powder form in concentration 25% and take the dosage from it 4 mg/g body weight and dissolved in drinking water and gave orally to mice, with water and food ad libitum.

Experimental animals

The male mice were kept in Gages for at least 7 days to acclimate to laboratory conditioning with an optimum temperature of 24 ± 2°C. The animals brought from National Center for Drug Control and Research. Male mice were 6–8 weeks old and weighed 19-29 g.

Experimental design

All the 20 experimental animals (mice) were divided into four groups containing five mice in each group. Group 1: This group treated with drink water for 7 days orally. Group 2: This group treated with 4 mg /g B.W MSG for 7 days orally. Group 3: This group treated with 4 mg/g B.W MSG for 14 days orally. Group 4: This group treated with 4 mg/g B.W MSG for 21 days orally.

Procedures

Organo-somatic index

The organo-somatic indicator of the liver, kidney and testes were then calculated for the 20 male mice to get the organ weight and the body weight ratios of the mice as follows: weight of the organ/whole mouse body weight × 100.

KS: kidney weight/whole mouse body weight × 100.

TS: testes weight/whole mouse body weight × 100.

Sperm abnormalities assay

The male mice sperm abnormality was tested according to with some changes. The male mice were sacrificed, and the epididymis were excised then minced with fine scissors in physiological saline in a petri dish. Smears were made on clean, grease-free slides after staining the cells with nigrosin and eosin dyes. The slides were air-dried and coded for subsequent examination under the microscope and different abnormalities were recorded. Cytological evaluation for sperm-head abnormalities was carried out using a binocular microscope at x1,000 magnification.

Statistical analysis

Statistical comparisons were made using the ANOVA test for the comparison of data in the control group and the experimental groups. The results are expressed as mean ± SEM (standard error of mean) and uses the less significant difference (LSD).

RESULTS

Organo-somatic index

The results showed that no significant differences in organo-somatic index between control group with the groups which administered 4 mg/kg body weight from MSG orally for 14 and 21 days, respectively, in the liver, kidney and testes Table 1. While there was a significant difference (P < 0.05) between control group in all organs (liver, kidney and testes) compared with 1-week Group, which administered 4 mg/kg body weight from MSG orally for 7 days in organo-somatic index. A significant increase in the weight of the mice was observed after the administration of MSG for 7 days with no change in the weight of the liver, kidney and testes. This leads to a decrease in the organo-somatic index.

Table 1. Mean of organo-somatic indicator in male mice which treated with 4mg/gm B.W of MSG for one, two and three weeks

<table>
<thead>
<tr>
<th>Groups</th>
<th>S-O index</th>
<th>HS M ± SE</th>
<th>KS M ± SE</th>
<th>TS M ± SE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td></td>
<td>6.66± 0.34</td>
<td>0.80± 0.04</td>
<td>0.35± 0.03</td>
</tr>
<tr>
<td>One week</td>
<td></td>
<td>6.66± 0.34</td>
<td>0.80± 0.04</td>
<td>0.35± 0.03</td>
</tr>
<tr>
<td>Two weeks</td>
<td></td>
<td>4.98± 0.32</td>
<td>0.57± 0.06</td>
<td>0.22± 0.03</td>
</tr>
<tr>
<td>Three weeks</td>
<td></td>
<td>5.95± 0.26</td>
<td>0.74± 0.06</td>
<td>0.30± 0.03</td>
</tr>
</tbody>
</table>

M: mean ; SE: standard error ; The small letter vertical differences refer to found significant differences (p<0.05).

We observed in Table 1, there was a significant difference between control group in all of organs (liver, kidney and testes) compared with 1-week group which administered 4 mg/kg body weight from MSG orally for 7 days in somatic-organ index. It means that the MSG causes change in the body weight.
Sperms abnormalities

Table 2 shows that the mean normal and abnormal sperms in mice used as a control group, and the other groups that administered 4 mg/g body weight of MSG for different periods. The results showed that the effect of MSG on the sperm abnormalities was found in male mice. There was a significant reduction in the normal sperms \((P < 0.05)\) of the mice that received MSG for 7, 14 and 21 days compared with the control group. There was no significant difference \((P > 0.05)\) between the mice that received MSG for 1 week and 3 weeks. However, the mean of normal sperms in the control group were significantly higher \((P < 0.05)\) than groups that were given of MSG orally for 1, 2 and 3 weeks, respectively. While there was no significant differences \((P > 0.05)\) between the group that received MSG for 1 week and 3 weeks. However, the sperm abnormalities represented in different shapes, like headless, tailless, hookless and abnormal sperm head, Figures 1, 2, 3, 4 and 5.

Table 2. Mean of sperms abnormalities in male mice which treated with 4mg/gm B.W of MSG for one, two and three weeks

<table>
<thead>
<tr>
<th>Groups</th>
<th>Abnormalities</th>
<th>Sum of abnormalities</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Normal sperm</td>
<td>Headless</td>
</tr>
<tr>
<td></td>
<td>M±SE</td>
<td>M±SE</td>
</tr>
<tr>
<td>Control</td>
<td>0.86±0.03 a</td>
<td>0.06±0.01 a</td>
</tr>
<tr>
<td>One week</td>
<td>0.73±0.02 b</td>
<td>0.04±0.01 a</td>
</tr>
<tr>
<td>Two weeks</td>
<td>0.37±0.04 c</td>
<td>0.15±0.02 b</td>
</tr>
<tr>
<td>Three weeks</td>
<td>0.63±0.03 b</td>
<td>0.14±0.02 b</td>
</tr>
</tbody>
</table>

The small letter vertical differences refer to found significant differences \((P < 0.05)\). * M: mean; SE: standard error.

Fig. 1 Normal sperm (400X, nigrosin & eosin)

Fig. 2 Abnormal head sperm in mice which treated 4mg/g MSG for one, two and three weeks (400X, nigrosin & eosin)
DISCUSSION

Obesity and excess weight are considered chronic conditions characterized by rising the body surplus specified by the rise in body weight of the patients. More recently, the integration of the excess weight wider spread of obesity and serious global ratio represents an important public health problem in many Western countries.

The results of animal studies suggest a possible link between the MSG and overweight/obesity. Mice treated with MSG have shown a significant increase in the weight compared to the control even at the consumption of similar quantities of food. Rogers found the overweight in rats that administered the MSG orally. MSG stimulates the receptors orosensory, which results in the effect of increasing appetite leading to weight gain. This may raise the idea that the MSG management may affect the way neglected for weight management.

MSG may cut male fertility. There are a number of possible manners to explain the impact of MSG. MSG’s ability to destroy nerve cells of the hypothalamus, a pointer that amends the neural control of the secretion of the hormone product through the hypothalamic pituitary gonadal axis organization. Such changes in the secretion of the hormone product may affect the productive capacity in treated animals. Unpublished evidence to prove that these high doses of MSG used in some parts of Nigeria to prevent the sexual instinct in the male goats. Such toxic effects on male reproduction may be only functional or anatomical depending on either produce structural changes in the genital tract or
influence the physiology producing, approves this proposal report.

In a related study, it was shown that rats treated with MSG showed morphological and morphometric changes. It also showed abnormalities of sperm compared with the control rats, which gradually improved after treatment with MSG stopped. In addition, research indicated that the MSG associated with the composition of free roots of oxygen and the occurrence of oxidative stress in different tissues of the experimental animals.

CONCLUSION

MSG used as food additives in a large number of foods caused the obesity and overweight, although it caused abnormalities in sperm shape and oxidative stress which linked to its toxicity. It led to the MSG that had toxicological effects.

REFERENCES
