Kerbala Journal of Veterinary Medical Sciences Issue (2), Volume (0), (2025)

The effect of monosodium glutamate in liver and kidney in male rabbit

Lamia. A. AL-Hasnawi

College of Veterinary Medicine, University of Kerbala , Kerbala , Iraq
Corresponding author: lamiaabdlmeer@gamil.com
Received: 18/9/2024 **Accepted:**12/1/2025 **Published:** 16/2/2025

Abstract— **This study aimed to investigate the ameliorative effects of Silymarin on monosodium glutamate toxicity. Twenty-eight local male rabbits, aged 3 to 4 months, were randomly allocated into four equal groups, each consisting of seven rabbits, and housed in experimental cages within the animal facility. The first group of animals received a basal diet as the control group (C). The second group (T1) was administered a basal diet supplemented with Monosodium glutamate (10 mg/100 g of body weight) orally. The third group (T2) was provided with water containing Monosodium glutamate (10 mg/100 g of body weight) and Silymarin (0.6 mg/100 g of body weight) orally. The fourth group (T3) received Monosodium glutamate (10 mg/100 g of body weight) dissolved in water along with Silymarin (1.2 mg/100 g of body weight) orally. The results indicated that hemoglobin concentration rose with time in the T3 group; however, the treated MSG groups exhibited significantly lower values ($P < 0.05$) than the control group during the majority of the examined period. The lymphocyte percentage in the T1 and T2 groups exhibited a substantial increase ($P< 0.05$) compared to the other groups, whereas the monocyte percentage in the T3 group shown a significant reduction ($P< 0.05$) in cholesterol concentration over the duration of this study relative to the other groups. The T3 group exhibited a statistically significant ($P < 0.05$) elevation compared to the other groups throughout the duration of this investigation. The triglyceride concentration in the T1 group exhibited substantially higher values ($P < 0.05$) compared to the control group at 63 days. The concentration of Alanine Aminotransferase (ALT) in the T1 group (MSG) of rabbits exhibited a considerably greater value ($P\leq 0.05$) compared to other groups over the 63-day period, while demonstrating significantly lower values in groups C and T3 relative to T1 and T2 over the duration of this study. The concentration of Aspartate transaminase (AST) exhibited substantial increases ($P\leq0.05$) in the T1 group (MSG) throughout the trial compared to the other groups. T3 had a significantly lower value ($P\leq0.05$) compared to other groups throughout the final stage of the study period. The creatinine concentration in the T2 group exhibited a substantially higher value ($P < 0.05$) compared to the other groups during the 63-day study period. In conclusion, it was determined that MSG had toxic effects on male rabbits, resulting in increased liver and kidney damage and oxidative stress, as seen by elevated levels of ALT, AST enzymes, creatinine, and cholesterol. Furthermore, the daily administration of Silymarin at a dosage of 1.2 mg per 100 g of body weight shown a beneficial effect on monosodium glutamate toxicity.**

Keywords — **Monosodium Glutamate, liver function, kidney function.**

I. INTRODUCTION

MONOSODIUM glutamate (MSG) is a prevalent flavor enhancer obtained from L-glutamic acid, a naturally occurring amino acid found in several food products(1,2). MSG exhibits a distinct flavor profile known as umami, initially recognized as a primary taste in Asia and subsequently acknowledged in Western cultures (1,3). This chemical was discovered around one hundred years ago by Kikunae Ikeda as the fifth fundamental taste, alongside sweet, sour, salty, and bitter. MSG is included in high-protein dietary items, including meat and fish, as well as specific cheeses (Roquefort and Parmesan) and vegetables (tomatoes, mushrooms, broccoli) (4, 5, 6). The umami taste, beyond its fundamental distinctiveness, can augment overall flavor intensity and boost food palatability. This effect is contingent upon various conditions, with the concentration of umami molecules and the food matrix being the most significant. (7).

IMP is utilized as a flavor enhancer to amplify the umami flavor of MSG (2). It is abundant in the body and ubiquitous in dietary proteins. MSG is mostly recognized for its flavor-

enhancing characteristics and is frequently used into Asian cuisine, canned veggies, soups, and processed meats. This chemical can activate the same sensory molecular processes associated with the "Umami" taste experience (6). The human body cannot differentiate between naturally occurring glutamate in food and added glutamate, as they are identical molecules. Considering its role as a fundamental component of proteins and the substantial daily consumption of glutamate as a protein constituent, the intake of free MSG and/or Umami possesses noteworthy potential health benefits by enhancing palatability and consequently food consumption, which may be advantageous in certain pathological or age-related conditions. (5).

Even in the context of healthy aging, nutritional deficiencies may result in age-related anorexia and/or sarcopenia. Various studies indicate that the stimulation of umami flavor enhances salivation, taste perception, hunger, and weight gain, hence contributing to the overall health of aged individuals (4–7). Various investigations and clinical trials have not shown a correlation between MSG consumption and potential adverse effects. Thorough examination of scientific material by several food safety bodies has led to the conclusion that MSG is deemed safe.

This research investigation was conducted from March to April 2014 in the Biology Laboratory, providing regular rabbit feed pellets and clean water ad libitum. Experimental Protocol Rabbits were randomly allocated into three groups, each consisting of six rabbits. Group 1 functioned as the control group and was administered normal saline (3 ml/kg body weight/day). Group 2 received a daily administration of 3 mg/kg body weight of MSG for 21 days, whereas Group 3 was administered 3 mg/kg body weight of MSG combined with 1 ml/kg body weight of soybean oil daily for the same duration. All medications were delivered orally via a gastric tube. On the 21st day (D21) of the dosing period, all animals were euthanized via exsanguination using a dissection kit, and blood samples were collected in plastic test tubes and let to stand for 30 minutes to ensure full coagulation. The clotted blood samples were centrifuged at 3000 rpm for 10 minutes, after which the clear serum samples were utilized for biochemical testing. Whole blood was utilized for hematological analysis, with Haber he being present in the body and abundant in dietary proteins.

II. Materials and Methods

A. Chemicals

Mono sodium glutamates, Propolis were supplied from El Dawlia for Chemicals Company and Medical Equipment, Egypt, and California Health Products, Inc. 11577W. CA90064. Los Angeles. Olympic Bivd, respectively.

B. Experimental groups and Animals

In this study, Male V-line rabbits with an initial weight of 3.200 ± 0.083 Kg and aged 6-7 months were utilized. Rabbits were acquired from the High Institute of Public Health, Alexandria University, Egypt. The animals were contained in enclosures. Water and feed were supplied ad libitum. Commercial pellets were supplied for rabbits (8). Twenty rabbits were allocated into four equal groups. The first group served as the control, the second group received propolis (8 mg/kg body weight), the third group was administered MSG (50 mg/kg body weight), and the fourth group received a combination of propolis (8 mg/kg body weight) and MSG (50 mg/kg body weight) simultaneously. The dosages of propolis and MSG were determined based on the body weight of the animals. Propolis and MSG were administered orally by syringe. The doses were administered daily for a duration of 12 weeks. Routine hematoxylin and eosin stains were used to general structure study. in addition to ether special stain (Masson ‘s trichrom stain) to give more histological details (9)

C. Blood samples collection and tissue preparations

Blood was collected from the ear vein of all rabbits at the conclusion of the 4th, 8th, and 12th weeks of the 12-week experimental period in heparinized tubes (anticoagulant). The centrifuge of the sample was operated at 860Xg for 20 minutes to extract the plasma, which was subsequently stored at -80°C until analysis. Animals were euthanized at the conclusion of the treatment period. The kidney and liver were excised; a cold saline solution was employed to wash the tissue, which was then chopped, homogenized (10%, w/v), and centrifuged at 10,000 Xg for 20 minutes at 4 °C, thereafter stored at -80 °C for the assessment of the measured parameters.

D .Histological examination

kidney and Liver tissues were excised and the specimens were preserved in 10% formalin. Paraffin was employed to fix the tissue, which was subsequently stained with hematoxylin and eosin (H&E) for examination under a light microscope (10).

III. Results

On Days 14 and 28 of MSG administration, no significant difference ($P > 0.05$) was observed between the mean blood LH concentrations of the treated groups and the control group (Table 1). On Day 56 of MSG delivery, the mean serum LH levels in treated Group D was considerably reduced ($P < 0.05$) compared to the untreated control (Table 1). On Day 14 of MSG treatment, the average testosterone levels in treated Group C was considerably reduced ($P < 0.05$) compared to the untreated control (Table 2). On Day 28 of MSG treatment, Group D exhibited a mean testosterone concentration that was considerably ($P < 0.05$) elevated in comparison to the untreated control group (Table 2). On Day 56 of MSG treatment, the mean blood testosterone concentration in treated Group C was significantly elevated ($P < 0.05$), whereas that in treated Group D was dramatically reduced ($P < 0.05$) compared to the control group (Table 2). Group C exhibited treatment effects in comparison to the untreated control on Day 28, but not on Days 14 and 56 of MSG administration. Nonetheless, there was no statistically significant ($P > 0.05$) change in the mean serum total cholesterol levels of the other treated groups (B and D) on Days 14, 28, and 56 of MSG treatment as compared to the untreated control group (Table 3). The average blood ALT activity in treated Groups B and C were significantly reduced ($P < 0.05$) compared to the untreated control on Day 56 of MSG

treatment. Nonetheless, on Days 14 and 28 of MSG administration, no significant ($P > 0.05$) difference was seen in the mean ALT serum activity among the groups (Table 4). Except for the treated Group D, which exhibited a substantially greater mean serum AST activity ($P < 0.05$) compared to the untreated control on Day 14 of MSG administration, no significant differences ($P > 0.05$) were seen in the mean serum AST activities.

Table 1: Mean serum luteinizing hormone concentration (IU/ml) of male rabbits administered various doses of MSG orally (± SEM)

Groups	A 0.0g/kg	B 0.25 g/kg	C 0.5 g/kg	D 1.0 g/kg
Day 14	0.06 ± 0.02 a	0.08 ±0.01 a	0.07 ± 0.02 a	0.06 ±0.02 a
Day 28	0.10 ± 0.06 a	0.03 ±0.01 a	0.14 ± 0.10 a	0.05 ±0.02 a
Day 56	0.06 ± 0.04 a	0.08 ±0.01 a	0.10 ± 0.02 a	0.01 ±0.02 b

Ab different superscripts within a row indicate significant differences between the means (P < 0.05)

Table 2: Mean serum testosterone concentration (nmol/l) of male rabbits administered various doses of MSG orally (± S.E.M.

Groups	A 0.0g/kg	B 0.25 g/kg	C 0.5 g/kg	D 1.0 g/kg
Day 14	30.47 ±13.21 a	37.17 ±3.57 a	2.08 ± 0.35 b	25.41 ±10.05 ab
Day 28	7.56 ± 4.13 a	22.12 ±10.82 a	6.80 ± 4.58 a	43.68 ±0.00 b
Day 56	3.50 ± 0.49 a	4.20 ±0.97 a	24.79 ±15.43 b	0.55 ± 0.52 c

Ab different superscripts within a row indicate significant differences between the means (P < 0.05)

Table 3: Mean serum total cholesterol concentration (mmol/l) of male rabbits administered various doses of MSG orally (± S.E.M.)

Groups	A 0.0g/kg	B 0.25 g/kg	C 0.5 g/kg	D 1.0 g/kg
Day 14	2.43 ± 0.60 a	2.72 ±0.51 a	2.22 ± 0.53 a	2.63 ± 0.42 a
Day 28	1.82 ± 0.13 a	2.01 ±0.19 a	1.21 ± 0.11 b	1.86 ± 0.20 a
Day 56	1.47 ± 0.07 a	1.42 ±0.24 a	1.28 ± 0.34 a	1.46 ± 0.07 a

Ab different superscripts within a row indicate significant differences between the means (P < 0.05)

Table 4: Mean serum ALT activities (nkat/l) of male rabbits administered various doses of MSG orally (± S.E.M.)

Groups	A 0.0g/kg	B 0.25 g/kg	C 0.5 g/kg	D 1.0 g/kg
Day 14	334.40 ± 48.0 a	419.75 ±39.67 a	402.75 ± 39.51 a	441.76 ±81.18 a
Day 28	357.74 ± 17.34 a	362.74 ± 6.50 a	377.58 ± 29.01 a	322.40 ± 23.67 a
Day 56	497.77 ± 42.34 a	370.91 ±33.01 b	377.08 ± 9.50 b	407.58 ±49.18 ab

Ab different superscripts within a row indicate significant differences between the means (P < 0.05)

IV. DISCUSSION

Monosodium glutamate markedly increased the levels of TBARS and substantially lowered the levels of reduced glutathione (GSH) and antioxidant enzymes. This outcome is comparable and corroborated by (11). The decrease in albumin levels in the MSG-treated rabbits parallels the observation made by (12), who observed that the MSG group had decreased serum albumin levels compared to the control group. Furthermore, (13) indicated that MSG therapy elevates the levels of urea and creatinine, attributable to the renal functional capacity, with whole or partial impairment of tubular excretion potentially disrupting creatinine metabolism. This conclusion is corroborated by (14), which indicated that propolis functions as a lipid peroxidation inhibitor and free-radical scavenger due to its antioxidant properties, leading to protective effects, enhanced antioxidant enzyme activity, and increased intracellular glutathione levels. Liver sections obtained from rabbits treated with MSG exhibited hepatocyte injury characterized by significant disruption of hepatic architecture. This outcome is consistent and corroborated by (15), who proposed that the alteration in liver cell structure transpires through oral administration of MSG. The presence of propolis demonstrated enhancement in hepatic architecture. This outcome is corroborated by (16), which indicated that propolis possesses antioxidant capabilities that improve fibrosis in hepatic architecture. The outcome of the kidney part from the MSG group is supported by previous studies (17,18). Furthermore, Vinodini *et al.* (13) suggested that oral administration of MSG resulted in morphological changes and oxidative stress in renal tissues. The combination of propolis and MSG shown enhancement of glomeruli and tubules. This conclusion is corroborated by (16), which demonstrated that propolis possesses antioxidant characteristics that alleviate fibrosis in the kidney. El-Kott and Owayss (19) and El-Kott *et al.* (20) indicated that propolis possesses anti-proliferative and anticarcinogenic properties.

V. CONCLUSION

The results indicated a decline in blood biochemical parameters, antioxidant enzyme activities, liver and kidney functions, as well as degradation of liver and kidney tissues as a consequence of MSG treatment. The results indicated that propolis enhances biochemical measurements and possesses antioxidant properties by elevating the activities of antioxidant

enzymes and restoring liver and kidney cells to a near-normal morphology.

VI. REFERENCES

1) Stanska K, & Krzeski A (2016). The umami taste: from discovery to clinical use. *Otolaryngologia Polska, 70(4), 10–15.*
2) Wifall TC, Faes TM, Taylor-Burds CC, Mitzelfelt JD, & Delay ER (2007). An analysis of 5'-inosine and 5'-guanosine monophosphate taste in rats. *Chemical Senses, 32(2), 161–172.*
3) Kurihara K (2015). Umami the Fifth Basic Taste: History of Studies on Receptor Mechanisms and Role as a Food Flavor. *BioMed Research International, 2015, 189402.*
4) Kochem M, & Breslin PA (2017). Clofibrate inhibits the umami-savory taste of glutamate. *PLoS One, 12(3), e0172534.*
5) Shigemura N, Shirosaki S, Sanematsu K, Yoshida R, & Ninomiya Y (2009). Genetic and molecular basis of individual differences in human umami taste perception. *PLoS One, 4(8), e6717.*
6) Yamaguchi S, & Ninomiya K (2000). Umami and food palatability. *The Journal of Nutrition, 130(4S Suppl), 921S–926S.*
7) Masic U, & Yeomans MR (2013). Does monosodium glutamate interact with macronutrient composition to influence subsequent appetite*? Physiology & Behavior, 116–117, 23–29.*
8) Childs, A.C., S.L. Phaneuf, A.J. Dirks, T. Phillips and C. Leeuwenburgh. (2002). Doxorubicin treatment in vivo causes cytochrome C release and cardiomyocyte apoptosis, as well as increased mitochondrial efficiency, superoxide dismutase activity, and Bcl-2: Bax ratio. *Cancer Res. 62: 4592-4598*
9) Bancroft, J. D., & Gamble, M. (Eds.). (2008). Theory and practice of histological techniques. *Elsevier health sciences.*
10) Kulalou, I., M. Faid and A.T.Ahami. (2004). Extending shelf of fresh minced Camel meat at ambient temperature by Lactobacillus delbrueckii. *J. Food Sci 7: 1-6.*
11) Selvakumar, E., C. Prahalathan, P.T.Sudharsan and P.Varalakshmi. (2006). Chemoprotective effect of lipoic acid against cyclo phosphamide-induced changes in the rat sperm. *Toxicology 217:71-78.*
12) Tawfik, M.S. and N.Al-Badr.(2012). Adverse Effects of Monosodium Glutamate on Liver and Kidney Functions in Adult Rats and Potential Protective Effect of Vitamins C and E. *Food and Nutrition Sciences 3: 651-659.*
13) Vinodini, N. A., A. K.Nayanatara, C. Ramaswamy, V. R. Anu, D. K.Rekha, G. K. M.Damadara, B. Ahamed and R.B. Shabarinath. (2010). Study on evaluation of monosodium glutamate induced oxidative damage on renal tissue on adult wistar rats," *Journal of Chinese Clinical Medicine 5(3): 144-147.*
14) Newairy, A.A. and H.M. Abdou. (2013). Effect of propolis consumption on hepatotoxicity and brain damage in male rats exposed to chlorpyrifos. *African Journal of Biotechnology 12, 5232-5243.*
15) Inuwa, H.M., V.O. Aina, G. Baba, I.O. Aim and J. Leehman. (2011). Determination of nephrotoxicity and hepatoxicity of monosodium glutamate (MSG) consumption. *British J. of Pharm and Tox 2(3):148-153: 2044-246.*
16) Araujo, M.A.R., S.A. Libério, R.N.M. Guerra, M.N.S. Ribeiro and F.R.F. Nascimento. (2012). Mechanisms of action underlying the anti-inflammatory and immunomodulatory effects of propolis: a brief review. Braz. *J. Pharmacognosy 22:208-219.*
17) Thomas, M., K.S.Sujantha and S.George. (2010). Protective effect of Piper longum Linn. On monosodium glutamate induced oxidative stress in rats. *Physiol Behav 99:334- 342.*
18) Paul, M.V., M. Abhilash, M.V. Varghese, M. Alex and N. R. Harikumaran. (2012).Protective effects of alpha-tocopherol against oxidative stress related to nephrotoxicity by monosodium glutamate in rats. *Toxicol Mech Methods 22: 625-630.*
19) El-Kott, A.F., A.A. Owayss. (2008). Protective effects of propolis against the amitraz hepatotoxicity in Mice. *Journal of Pharmacology and Toxicology 3:402-408.*
20) El-kott, A.F., A .A. Kandeel, S.F. Abed El-Aziz, H.M. Ribea. (2012). Effects of bee honey on PCNA and P53 expression in the rat hepatocarcinogenesis. *International Journal of Cancer Research 8:130-139.*