

The harmful Effects of Monosodium Glutamate on Blood Parameters Liver and Kidney Functions In Adult White Rats and the Protective Role of Omega-3

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Abstract

The present study was conducted to find out the harmful effect of exposure to monosodium glutamate (MSG) on laboratory animal weight, hematological and biochemical parameters on rats of 10 -15 weeks old and weight of 100-200 g. Whereas, this study was conducted in the Basic Sciences Branch - College of Nursing - University of Warith Alanbiyaa From 11/1/2019 to 2/1/2020, the animals were divided into four groups

G 1- Control The first group control

G 2- MSG (1.8mg / kg) Group II

G 3 - MSG (1.8 mg / kg) + omega-3 (0.8 mg / kg) Group III

G 4 - MSG (1.8 mg / kg) + omega-3 (1.2 mg / kg) Group IV

Where the four groups were fed according to

The above distribution is according to the concentrations in each group effect of MSG at one oral low dose of 1.8 mg/g body wt. on liver and kidney functions in albino rats. The possible protective effect of omega 3 (at oral dose of 0.8 mg/g body wt.) (at oral dose of 1.2 mg/g body wt.) against MSG induced hepatic and renal stress was also investigated of mono-sodium glutamate for 30 days.

The results showed a significant decrease ($p < 0.05$) in blood parameters, including RBC count 5.1 ± 0.7 and concentration of PCV: 14.5 ± 0.33 , MCH: 34.5 ± 2.77 , MCV: 96.5 ± 3.21 , MCHC: 34.0 ± 0.89 . Compared with the control group indicating anemia in MSG treated animals.

There was a significant increase in the biochemical parameters (AST: 216 ± 14.8 , ALT 3.6 ± 0.40 , ALP 144.75 ± 6.55). And also in the Urea - Creatinine kidney standards

Which represents the liver function in animals treated with monosodium glutamate compared with the control group, despite a significant increase ($P < 0.05$) in the level of urea 2.70 ± 0.07 and creatinine 0.098 ± 0.005 in the blood in the animal treated with MSG compared with the control group.

Keywords: *mono sodium glutamate, blood parameters, biochemical*

Introduction

Monosodium glutamate (MSG) is a chemical compound with the formula $C_5H_8NNaO_4$, also known as E621, and white crystals [1]. It is used as a dietary

supplement, is one of the most widely used food additives in the world, and is found in the majority of processed foods [2]. The combined effect of glutamic acid in vegetable protein increases the sensation of flavor eight times that of the original ingredients; as a result, its use

has spread to increase the palatability of protein foods and reduce the need for salt. It has the ability to produce a distinct flavor known as umami, which improves the quality of food [2]. It can be found in a variety of processed foods, including canned chips, snacks, soups or sauces (canned or packed), frozen foods, and others [3]. Monosodium glutamate (MSG) is classified as a safe substance by the Food and Drug Administration (FDA) in 1959 [4]. However, empirical studies have revealed that long-term MSG consumption causes a number of toxic effects known as the Chinese restaurant syndrome [4, 5]. Sweating, nausea, headache, chest tightness, and burning at the back of the neck are symptoms of this syndrome [6]. Furthermore, long-term MSG consumption causes an increase in appetite, obesity, asthma, poor memory, and nerve cell damage; additionally, research has shown that MSG can cause brain damage in infants. According to those studies, it has been removed from baby food [7, 8]. The purpose of this study was to look into the effect of MSG exposure on biochemical and blood parameters in albino rats. The liver is the mammalian body's largest gland. Hepatocytes have metabolic functions that deal with very important processes such as detoxification, deamination, transamination, ammonia removal in the form of urea, biosynthesis and release of non-essential amino acids and plasma proteins with the exception of immune gamma globulins, gluconeogenesis, and glycogenolysis.

Storage of glycogen, conversion of carbohydrates and proteins to lipids, synthesis of lipoproteins, phospholipids, and cholesterol, oxidation of fatty acids, iron storage as ferritin, and storage of vitamins A, D, and B12. A number of functional tests have been developed to investigate hepatic status [12-16]. Several enzymes, such as alanine amino transferase (ALT) and aspartate amino transferase (AST), have been identified to investigate hepatic status (AST) [17]. Other tests that are used include serum lactic dehydrogenase (LDH), gamma-glutamyl transferase (GGT), alkaline phosphatases, and 5-nucleotidase activities [18-20]. The kidney is a paired organ located in the posterior abdominal wall whose major functions include the removal of toxic metabolites and waste products from the blood as well as the regulation of the body's fluid and electrolyte

balance [21]. Routine urinalysis is used to assess kidney function by measuring serum urea, creatinine, sodium and potassium, and serum bicarbonate [13,19-22]. Because of their easy, effective, and safe dietary administration in a wide range of concentrations, omega 3 (Vitamins) play an essential role in almost all biochemical reactions and are ideal antioxidants capable of increasing tissue protection from oxidative stress [23-24]. Vitamin E (-Tocopherol [(α -Toc)]) is a lipid-soluble, chain-breaking antioxidant that protects cell membranes from lipid peroxidation [25-28].

Pretreatment with omega 3 (Vitamin E) has been shown to be beneficial in preventing formaldehyde-induced tissue damage in rats [26-29].

The antioxidant activity of vitamin E is suggested by its ability to prevent cypermethrin or endotoxin-induced oxidative stress in rat tissues [30-22].

The purpose of this study was to investigate the effect of MSG at a low dose of 1.8 mg/g body weight on liver and kidney functions in albino rats. The potential protective effect of omega 3 (at an oral dose of 0.8 mg/g body weight) (at an oral dose of 1.2 mg/g body weight) against MSG-induced hepatic and renal stress was also investigated [31-32].

Materials and Methods

Experiment Design

The current research was carried out at the Basic Medical Sciences Branch - College of Nursing - Warith Al-Anbiya University, peace be upon him, at a time when The animals were divided into four groups from 11/1/2019 to 2/1/2020. 40 adult male rats weighing 100-200 g and aged 10-15 weeks were used in the study. The animals were subjected to standard experimental conditions, which included temperatures ranging from 22 to 25 C° and lighting lasting 12 to 13 hours. The animals were left for a week to adapt before being randomly divided into four groups of ten animals each. The first group was fed the standard rat diet and was considered a control group, while the second group was fed

For 30 days, rats were fed the standard rat diet plus MSG at a rate of 1.8 g/kg.

Blood sampling

At the end of the experiment, the animals were sacrificed and blood samples were taken directly from the heart. Blood samples were taken from each animal, ranging from 3-5 ml of blood divided into two parts. The first was placed in test tubes containing EDTA to perform the blood tests, while the remaining blood was placed in a plain test tube until coagulation occurred. The serum samples were then separated by centrifugation 2500-3000 cycles per minute.

Laboratory analysis

The blood tests were performed using the automated sysmex (USA) blood analysis system^[9]. The automated chemistry auto analyzer, manufactured by the German company Human^[10], was used to conduct biochemical tests.

Statistical analysis

The data was analyzed with the Statistical Program for Social Sciences (SPSS) using a statistical test (T-test) at a probability level of ($p < 0.05$).

Results and Discussion

The current study found a significant decrease ($p < 0.05$) in RBC count, Hb concentration, and PCV in animals treated with monosodium glutamate compared to the control group (Table 1). The reduced number of erythrocytes can be attributed to the possibility that MSG reduced the half-life of red blood cells, which could be due to salt's direct toxicity on cells. It can also be attributed to the effect of salt on bone marrow red blood cell stem cells.

An increase in oxidative stress caused by MSG exposure can also explain red blood cell damage [11]. Reduced erythrocyte numbers result in a decrease in the percentage of PCV and concentration of Hb. MCV and MCH are shown in Table (1), indicating a significant increase ($p < 0.05$) in their concentrations.

concentrations in the treatment group Increased MCV indicates an increase in cell.

dimension (macrocytic). MCV increases in pernicious anemia and megaloblastic anemia^[12]. while in some types of anemia, increased MCH occurs in conjunction with large cell size (macrocytic anemia).

The low concentration of MCHC can be attributed to low hemoglobin levels in the blood and decreased PCV, which are the main determinants of MCHC, indicating anemia^[13]. The results of the present study are identical to those of^[14] and not in accordance with what^[15].

The current study's findings revealed a significant increase ($p < 0.05$) in some biochemical parameters (Table 2).

A significant increase in concentrations of AST, ALT, and ALP, which represent liver function, was observed in animals treated with mono-sodium glutamate compared to the control group; this increase can be attributed to damage in liver cells, where the greater the damage, the greater the increase in hepatocytes the more these enzymes are released into the bloodstream^[16].

Because these food additives cause degeneration and destruction of the liver cells and their cellular membranes, these enzymes are naturally found inside the cells and are released into the bloodstream in the event of cell breakage or cell membrane damage^[17].

The increased concentration of ALP in the serum of animals treated with MSG can be attributed to intestine and gallbladder damage. This enzyme is found in the intestines and gallbladder in addition to hepatic cells^[18].

Table 2 shows the renal function results, which show a significant increase ($p < 0.05$) in serum urea and creatinine levels in animals treated with mono-sodium glutamate compared to the control. This can be explained by a change in the tubular reabsorption threshold, as well as the glomerular filtration rate^[19].

Conclusion

The current study concludes that MSG has an effect on blood parameters by lowering Hb, PCV, RBCs, and

MCHC while increasing MCV and MCH. MSG also has an effect on renal and liver functions, as evidenced by increased serum creatinine, blood urea, and liver enzymes (ALP, AST, ALT).

Table 1: Effect of monosodium glutamate on some blood parameters in rats

parameters Groups	RBC x106/mm ³	HB g/dl	PCV %	MCV fl	MCH pq	MCHC g/dl
G 1 Control (normal saline)	5.1 ±0.7 a	14.5 ±0.33 a	45.5 ±0.61 a	96.5 ±3.21 b	34.5 ± 2.77 b	34.0 ± 0.89 a
G 2 MSG (1.8mg/kg)	4.1 ±0.19 b	12.33 ±0.40 b	38.1 ±1.80 b	109.8 ±2.55 a	37.3 ±3.31 a	30.1 ± 0.34 b
G 3 MSG(1.8 mg/kg) + omega-3 (0.8 mg/kg)	3.8 ±1.10 b	11.99 ±0.80 b	35.02 ±1.30 b	121.03±2.60 a	42.01 ±3.20 a	28.11 ±0.70 b
G 4 MSG(1.8mg/kg) + omega-3 (1.2 mg/kg)	4.9 ± 1.80 b	14.1 ±0.97 b	39.96 ± 0.99 b	100.22±3.10 b	36.55 ± 2.90 b	32.99 ± 0.81 b

Different letters represent significant difference at ($p \leq 0.05$).

Table 2: Effect of monosodium glutamate on some liver and kidney functions in rats

parameters Groups	AST (U/L)	ALT (U/L)	ALP (IU/L)	Urea (mg/dl)	Creatinine (mg/dl)
G 1 Control (normal saline)	216 ± 14.8 b	3.6 ± 0.40 B	144.75 ± 6.55 b	2.70 ± 0.07 b	0.098 ± 0.005 b
G 2 MSG (1.8mg/kg)	258 ± 9.03 a	4.9 ± 0.38 A	166.32 ± 2.65 a	3.90 ± 0.28 a	0.15 ± 0.03 a
G 3 MSG(1.8 mg/kg) + omega-3 (0.8 mg/kg)	265 ± 4.03 a	4.5 ± 0.48 A	160.02 ± 3.11 a	3.22 ± 0.44 a	0.13 ± 0.05 a
G 4 MSG(1.8mg/kg) + omega-3 (1.2 mg/kg)	222 ± 3.10 a	3.9 ± 1.42 A	150.02 ± 2.10 a	2.80 ± 0.40 a	0.10 ± 0.05 a

Different letters represent significant difference at ($p \leq 0.05$).

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Conflict of Interest: None to declare.

Ethical Clearance: “All experimental protocols were approved under the College of Nursing and carried out in accordance with approved guidelines”.

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