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Study on effect of glutamate monosodium exposure on some blood and biochemical parameters in adult albino rats

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Abstract
The present study was conducted to investigate the effects of exposure to monosodium glutamate (MSG) on blood and biochemical parameters in 10 to 14 week old rats. The study was conducted at department of Biology - College of Education –Pure Sciences - University of Thi Qar from (10/1/2014- 10/2/2014). The animals were divided equally into two groups. The first group fed with the standard rat's diet, this group was considered as a control group, while the second group fed with standard rat's diet plus 5 g / kg of mono-sodium glutamate for 30 days. The results showed a significant decrease ($p < 0.05$) in blood parameters, including RBCs count 5.1 ± 0.72, Hb concentration14.5 ± 0.33, PCV 45.5± 0.61, MCHC 34.0 ± 0.89 in animals treated with MSG compared with control group which indicate of anemia in animals treated with MSG. That there was a significant increase ($p < 0.05$) in biochemical parameters AST 216 ± 14.8, ALT 3.6 ± 0.40, ALP 14.75 ± 6.55, which represent liver functions in animals treated with monosodium glutamate Compare with control group, though significant increase ($p < 0.05$) in the level of serum urea and creatinine in animal treatment monosodium glutamate compared with the control group. The study suggests that monosodium glutamate, despite its flavoring functions, is considered harmful to health.

Keywords: mono sodium glutamate, blood parameters, biochemical

Introduction
Monosodium glutamate (MSG) is a chemical compound that has a chemical formula C5H8NNaO4 also called E621, has white crystals [1]. It is used as a dietary supplement, it is one of the most widely used food additives worldwide and is added to most processed foods [2]. The combined effect of glutamic acid in vegetable protein increases the sensation of flavor eight times of the original ingredients, its use has therefore been spread to increase the palatable protein foods and reduce the need to add salt. It can produce a unique taste known as taste (umami) that improves the quality of food [2]. It is found in a wide range of processed foods including canned chips, snacks, soups or sauces (canned, packed) frozen foods, and other foods [3]. The Food and Drug Administration (FDA) classifies monosodium glutamate (MSG) as a safe substance in 1959 [4]. However, empirical studies have shown that prolonged consumption of MSG causes a number of toxic effects, referred to as the Chinese restaurant syndrome [4, 5]. Symptoms of this syndrome are sweating, nausea, headache, chest tightness and burning at the back of the neck [6] . Moreover, the long-term intake of MSG result in an excess of appetite, obesity, asthma, poor memory, and damage to nerve cells, at the same time, researches has shown that MSG can cause brain damage in infants. Based on those researches, it has been removed from baby food [7, 8]. The present study was aimed to investigate the effect of MSG exposure on biochemical and blood parameters in albino rats.

2. Materials and Methods
2.1 Experiment Design
The present study was conducted at department of Biology - College of Education –Pure Sciences - University of Thi Qar at a period (10/1/2014- 10/2/2014). Twenty adult male rats weighing 150-200 g and 10-14 weeks' age were used. The animals were placed in standard experimental conditions, including temperatures ranging from 22 to 25 Cº and lighting ranging from 12 to 13 hours. The animals were left for a week for the purpose of adaptation, and then randomly divided into two groups 10 animals in each group. The first group was fed on the standard rat diet; this group was considered a control group while the second group was fed on

the standard rat diet plus MSG 5 g / kg for 30 days.

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

2.3 Laboratory analysis
The blood tests were carried out directly using the automated sysmex (USA) blood analysis system [9]. Biochemical tests were carried out using the automated chemistry auto analyzer, manufactured by German company Human [10].

2.4. Statistical analysis
The results were analyzed using the Statistical Program for Social Sciences (SPSS) using a statistical test (T-test) at a probability level ($p < 0.05$).

3. Results and Discussion
The results of the present study showed that there was a significant decrease ($p < 0.05$) in RBCs count, Hb concentration, PCV, in animals treated with monosodium glutamate compared with control group (Table 1). Reduced number of erythrocytes can be attributed to the possibility that MSG led to a reduction in half-life of red blood cells, which may be due to the direct toxicity of salt on cells. It can also be attributed to the effect of salt on red blood cell stem cells in the bone marrow. Red blood cell damage can also be explained by an increase in oxidative stress due to exposure to MSG [11]. Reduced numbers of erythrocytes result in a decrease in the percentage of PCV and concentration of Hb. MCV and MCH shown in Table (1) which indicates a significant increase in ($p < 0.05$) in their concentrations in the treatment group Increased MCV indicates an increase in cell size (macrocytic). Increased MCV occurs in pernicious anemia, megaloblastic anemia [12]. while increasing MCH is occurring in some types of anemia accompanied by large cells size (macrocytic anemia). The low concentration of MCHC can be attributed to the low concentration of hemoglobin in blood and the reduced PCV, which are the main determinants of MCHC, which is a clear evidence of anemia [13]. The results of the present study are identical to those of [14] and not in accordance with what [15].

The results of the present study showed that there was a significant increase ($p < 0.05$) in some biochemical parameters (Table 2). A significant increase was observed in concentrations of AST, ALT, ALP, which represent liver function in animals treated with mono-sodium glutamate compared to control group, this increase can be attributed to damage in liver cells, Where the greater the damage in hepatocytes the more these enzymes are released into the bloodstream [16]. As these food additives cause degeneration and destruction of the liver cells and their cellular membranes, these enzymes are found naturally inside the cells and are released into the blood circulation in case of cell breakage or cell membranes [17]. With regard to the increased concentration of ALP in the serum of animals treated with MSG, it can be attributed to the damage to the intestine and gallbladder. In addition to hepatic cells, this enzyme is present in the intestines and gallbladder [18]. The results of the renal function shown in Table 2 showed 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 threshold of tubular reabsorption, Glomerular filtration rate [19].

4. Conclusion
The current study concludes that MSG has effects on blood parameters causing reduce Hb, PCV, RBCs, and MCHC and increase MCV, MCH. Renal and liver functions also affected by MSG, this appear through increase 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/mm3	HB g/dl	PCV %	MCV fl	MCH pq	MCHC g/dl
Control	5.1 ± 0.72 a	14.5± 0.33 a	45.5± 0.61 a	96.5± 3.21 b	34.5± 0.77 b	34.0± 0.89 a
MSG	4.1± 0.19 b	12.33± 0.40 b	38.1± 0.90 b	109.8± 2.55 a	37.3± 3.31 a	30.1± 6.34 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)
Control	216 ± 14.8 b	3.6 ± 0.40 B	140.75 ± 6.55 b	2.89 ± 0.07 b	0.098 ± 0.005 b
MSG	258 ± 9.03 a	4.9 ± 0.38 A	176.32 ± 2.65 a	3.90 ± 0.28 a	0.15 ± 0.03 a

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