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Changes in Lipid Profile and Heart Tissues of Wistar Rats Induces by Using Monosodium Glutamate as Food Additive

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Research article

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Abstract

Aim of study is to evaluate the influence of Monosodium glutamate on lipid profile (Cholesterol, Triglyceride, LDL and HDL) and heart tissues of Wistar rats. Group one represented non treated rat(Control), group two received 0.5 g monosodium glutamate ((MSG), group three received i.0 g MSG and group four received 1.5 g MSG. Results indicated that significance increasing in serum cholesterol, triglyceride, LDL (low density lipoprotein), HDL (High density lipoprotein) with increasing the dose of MSG. In addition, change in heart tissues of rats is clear observed in low, mid and high dose of MSG compared with non- treated rats. The experiment was clear indicated the effect MSG on lipid profile and heart tissues of Wistar rats.

Keywords: Monosodium Glutamate; Cholesterol; Triglyceride; Heart Tissues

Introduction

Noodles are dried pre-cooked food sold packets as powder. Noodles is made of wheat flour, vegetable oil, ionized salt, sodium phosphate, sodium carbonate, potassium carbonate, guar gum, tartazine, antioxidant [1]. While seasoning powder of noodle contains ionized salt, monosodium glutamate, hydrolyzed vegetable protein, soy powder, pepper, garlic powder, chicken flavor and chili powder. It is eaten as snacks and major meal. It attracts nearly all individual age. Noodle brands from nutritional value it contains high carbohydrates, sodium and fat without additional ingredients such as egg, meat and vegetables [2]. The seasoning powder of noodle contains ionized salt, monosodium glutamate (MSG), pepper; chicken flavor and garlic powder [3]. Monosodium glutamate (a sodium salt of naturally occurring L-form of glutamic acid) is one of the commonest food additives in the developed and developing world and can be found in numerous food products [4]. Monosodium glutamate is widely used as food additives and flavor enhancer in all over the world. It is added to many foods such as canned vegetable, Chinese food, sauce, soup and processed meat. MSG is the sodium salt of glutamic acid, one of the most abundant naturally occurring non-essential amino acids, glutamate is one of the main components of many proteins and peptides of most tissues and can be found in many protein-rich food products such as meat, fish, cheese, milk, tomato, and mushroom.MSG is a flavor enhancer and approximately contains 78% glutamic acid, 22% sodium and water [4]. MSG benefits to the food industry are quite clear; this food additive could be slowly and silently doing major damage to our health. It is known to have some adverse effect in

human and experimental animals. MSG induces appetite positively and stimulates weight gain due to its irritation of the ornosensory receptors and enhancing the palatability of food [5]. Dried noodle pieces are cooked or absorbed boiling water before expending [6]. Levels of free glutamate in foods of animal are quite low in beef 33 mg/100 g and in cows' milk 2 mg/100 g), while the higher levels in vegetables such as in seasoning, sauce and restaurant foods is about 30-200 mg/100 g [7]. Cholesterol is a waxy substance made by animal liver and also supplied in diet through animal products such as meats, poultry, fish and dairy products. Cholesterol is needed in the body to insulate nerves, make cell membranes and produce certain hormones, and it is an important lipid in some membranes. However, the body makes enough cholesterol, so any dietary cholesterol isn't needed. Cholesterol plays a major role in human heart health. Cholesterol can be both good and bad. High-density lipoprotein (HDL) is good cholesterol and low-density lipoprotein (LDL) is bad cholesterol. High cholesterol in serum is a leading risk factor for human cardiovascular disease such as coronary heart disease and stroke [8]. Normal range of cholesterol is 125 – 200 mg/dl [9]. High-density lipoprotein is one of the five major fat and protein particles (lipoproteins) whose role it is to enable blood fats (lipids), such as cholesterol and triglycerides, to be transported within the water-based bloodstream. Commonly it referred to as the good cholesterol .HDL is the smallest and densest of the lipoproteins, containing the highest proportion of protein to cholesterol. In a normal healthy individual, HDL carries about a quarter of the total amount of cholesterol in the blood, whereas most of the remainder is carried in LDL (low density lipoprotein) "bad cholesterol" particles (HEART –US-www.heartuk.org.uk) [10]. Normal level of HDL for male rat is 40 mg/dl while for the female rat is 50 mg/dl [9]. LDL cholesterol is often referred to as bad cholesterol. LDL conveys cholesterol from the liver to the cells. If the LDL concentration in the blood is too high, it precipitates in the arteries. This leads to a risk of arterial diseases. The average LDL component of human blood lipoprotein is 70%, but this may vary depending on the person's life-style [11]. Normal level of LDL cholesterol is less than 100mg/dl [9]. Triglycerides are fats which are found in foods such as meats, dairy produce and cooking oils. Triglycerides are absorbed in the intestines and transported by the bloodstream to the tissues where they are either stored as fat or used to provide energy. Fat that is stored is also comprised of triglycerides. Triglycerides are also made in the liver. For example, when more calories are consumed than your body requires, the liver forms triglycerides from the excess energy and these are then stored as fat. Normal level of Triglycerides is less than150 mg/dl [9].

The objective of this study is to investigate the adverse effect of oral consumption of monosodium glutamate on lipid profile in experimental rats and study effect of supplement MSG on heart tissues.

Material and Methods

Experimental Animals

The experiment was conducted on 8 normal adult male albino rats with an average weight from 94- 100 g. the animals were kept in standard neat metallic and well ventilated cages. They maintained on standard healthy laboratory conditions at temperature of 18-24°C and an appropriate humidity and lighting. They had access to 12hr of darkness and 12 hours of daylight. All rats had free access to drinking water and food.

Experimental Design

During the experimental period, they were fed with standard pellet during the experimental period. They were fed with standard pellet diet (consisting of 60% starch, 20% casein, 10% cotton seed oil, 4% salt mixture, 5%cellulose, and 1% vitamin mixture). After the adaptation period of 14 days, the rats were distributed into 4 equal groups, each contained 3 rats. Group I (G_1) represented the healthy control animals and received distilled water. The second group (G_2, low dose) received 0.5 g MSG, third group (G_3, mid dose) received1.0 g MSG, and fourth group (G_4, high dose) received 1.5 g MSG with daily supply of drinking water for 3 weeks.

Preparation of Monosodium Glutamate

0.5 g of MSG was dissolved in 2ml of water for group one (low dose). 1g of MSG was dissolved in 2ml of water for group two (medium dose).1.5 g of MSG was dissolved in 2ml of water for group three (high dose).

Blood Collection and Samples Preparation

Pre samples has been taken from the eye of each groups by heparinized capillary tube and kept in specific labeled plain container. Serums were separates by centrifuge at 5000 rpm for 5 minutes and stored in freezer until analysis. At the end of the experimental period of 3 weeks, blood was collected from each rat individually for biochemical assay. The animals were fasted for twelve hours prior to blood collection. All animals were anesthetized by chloroform and blood

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samples were collected immediately from their heart using heart puncture technique with the aid of disposable sterile syringe and needle (Sigma). Blood samples were then transferred into capped tubes with no anticoagulant,. The blood was allowed to clot at room temperature for 30 minutes prior to centrifugation at 2500 rpm for 20 minutes using centrifuge to obtain the serum for biochemical analysis. The yellow serum supernatant was removed. The spectrophotometer Analyzer was used to determine the concentration of serum triglycerides, total cholesterol, low density lipoproteins (LDL) and high density lipoprotein (HDL). This machine is a fully automated and composed of an analytical unit which produces chemical reactions in samples, an operation unit which inputs and outputs analytical conditions, and a control unit which controls each function required for operation of the instrument.

Methods

Serum Cholesterol: It was determined according to method described by Meiattini, et al. and Allain, et al. [12,13].

Serum Triglyceride: It was determined according to method described by Friedman and Young; Fassati and Prencips [14,15].

Serum high density protein (HDP): It was determined according to method described by Burstein, et al. and Grove [16,17].

Serum low density protein (LDP): It was determined according to method described by Salah, et al. [18].

Histology Sample Processing

Statistical analysis: the heart tissue was fixed in 4%formldehyed for sample preservative , then the tissue was dehydrated by passing it through increasing of ethyl alcohol (from 0 to 100%) this step called (processing). After replacement occurs, the alcohol was replaced with xylene, which is miscible with alcohol. This step is called (clearing), then, tissue was embedded in paraffin wax which becomes hardened was sectioned using rotary microtome. The sections where rehydrated by passing through xylene, and then decreasing strength of alcohol (100% to 0%) and finally water, and stain with heamoxlyin and eosin and then dehydrated again using xylene, then mounted on the microscope slide, a cover slip was placed on top, to protect the sample which read under microscope in 40X.

Data was statistically analyzed by using one-way analysis of variance and the unpaired t-test.

Results and Discussion

Lipid Profile

Table 1 indicated that mean values of free cholesterol for G_1, G_2, G_3 and G_4 are100.6±0.55, 117.3±0.6, 164.7±0.49 and 210.7±0.25 mg/dl, respectively. These results are clearly illustrated that the cholesterol level was significance increased in low, mild and high doses compared with control at level $P \leq 0.05$. The findings are agree with those results obtained by Saeed [19]. The level of cholesterol obtained for G_2 and G_3 within normal range (125- 200 mg/dl), but cholesterol level of G_4 is greater than those finding by Huizen [9]. Therefore, these treated rats are subjected to cardiovascular disease such as coronary heart disease and stroke due to increasing the concentration of SMG. Whereas, mean values of Triglyceride for G_1, G_2, G_3 and G_4 are118.6±1.66, 60.7±0.68, and 177.39±20 and 225.3±63 mg/dl, respectively. These results are clearly illustrated that the triglyceride levels are significance increased in low, mild and high doses compared with control at level $P \leq 0.05$. These findings are similar to those results obtained by Saeed [20]. The level of triglyceride obtained for G2 is low while for G3 and G4 is higher than those values reported by Huizen [9]. Therefore, when consumed calories are greater than requirement of body, then liver forms triglycerides from the excess energy and these are stored as fat. While mean values of LDL-C for G_1, G_2, G_3 and G_4 are 37.6±0.7, 55.3±0.77, 59.6 ±0.9 and 69.8±0.42 mg/dl, respectively. These findings are indicated that mean value of LDL-Cholesterol was significance increased in low, mild and high dose compared with control at level $P \leq 0.05$. The range of LDL-C obtained is 55.3 – 69.8 mg/dl which is lower than range (38 – 85 mg/dl) reported by Colpo [11]. If the LDL concentration is high in blood, then it is precipitate in artery (arterial disease). Therefore, LDL is known as bad cholesterol. Mean values of HDL-C for G_1, G_2, G_3 and G_4 are 43.71±0.09, 41.18±0.73, and 43.90±0.57 and 65.75±0.64 mg/dl, respectively. These findings are indicated that HDL-C was significance decreased in G_2 and G_3, but increased in high in G_4 compared with control (G_1) at level $P \leq 0.05$. These results are contradicted to previous study which reported significance decrease in the concentrations of serum HDL in G_2 and G_3but, increasing in G_4 [20]. This contradiction may be due to immaturity of rats or short period of experiment. The range of HDL-C obtained is 41.2 – 65.8 mg/dl which greater than normal range (21 – 54mg/dl) reported by (HEART-UK- www.heartuk.org.uk). The ratio of cholesterol to HDL for G1, G2, G3, and G4 is 2.28, 2.84, .75 and 3.19, respectively. The results are indicated that ratio of cholesterol to HDL is increased with increasing doses of

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monosodium glutamate to experimental rats compared with the control group. These findings are similar to those results reported by (HEART-UK- www.heartuk.org.uk) [10,21-25].

Items / Doses	Group of control (G_1)	Group of low dose(G_2)	Group of mid dose(G_3)	Group of high dose(G_4)
Cholesterol (mg/dl)	100.60±0.55	117.30±0.6	164.70±0.49	210.70±0.25
Triglyceride(mg/dl)	118.60±1.66	60.70±0.68	177.40±0.20	225.30±0.63
LDL-C(mg/dl)	37.60±0.7	55.30±0.77	59.60±0.9	69.80±0.42
HDL-C(mg/dl)	43.700.09	41.20±0.73	43.90±0.57	65.80±0.64
Ratio Cholesterol: HDL	2.28	2.84	3.75	3.19

Table 1: shows effect of Sodium Mono glutamate on Cholesterol, Triglyceride, LDL-C and HDL-C in Wister rats.

Histopathology

Figure 1: represents control (not treated with monosodium glutamate. There is no change in heart tissues of Wistar rats. Figure 2 showed slightly change in heart myofibers of Wister rat treated with low dose (0.5g). Figure 3 indicated degenerations change on heart tissues of Wister rat treated with medium dose (1.0g). Figure 4 indicated congestions change and hemorrhage on heart tissues of Wister rat treated with high dose (1.5g).

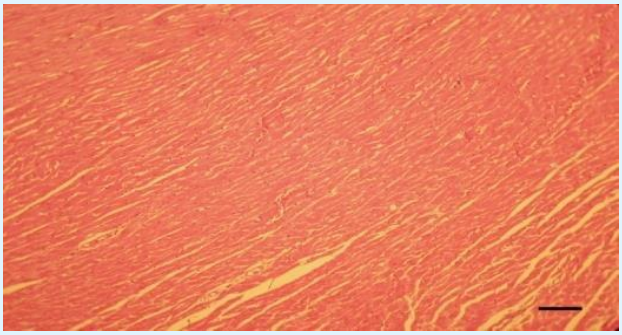

Figure 1: Normal heart tissues of non-treated Wistar rats with Monosodium glutamate.

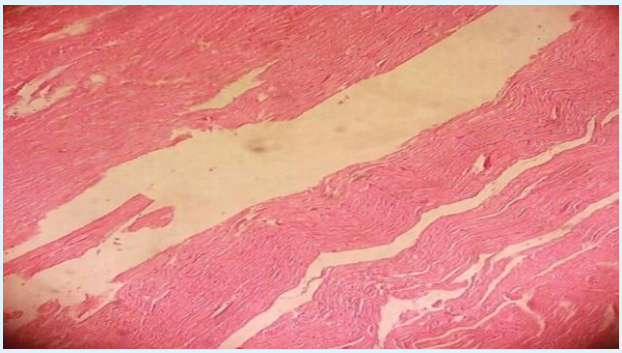

Figure 2: Heart tissues of treated Wistar rats with 0.5 g Monosodium glutamate.

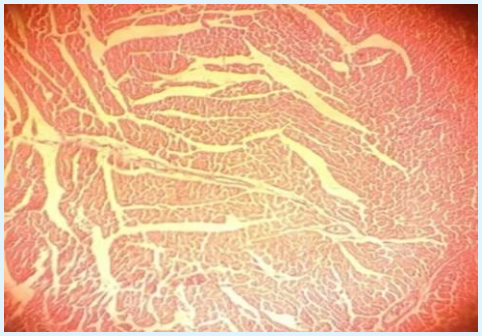

Figure 3: Heart tissues of treated Wistar rats with 1.0 g Monosodium glutamate.

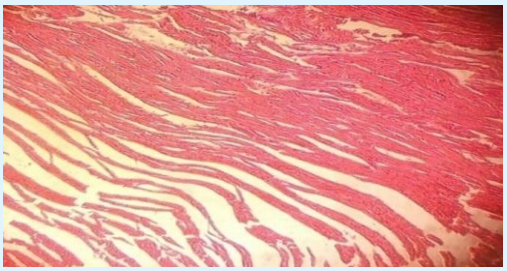

Figure 4: Heart tissues of treated Wistar rats with 1.5 g Monosodium glutamate.

Conclusion

The present study concluded that MSG effect on lipid profile (Free Cholesterol, triglyceride, LDL and HDL-C) is significance increase in low, mid and high dose compared with control. Monosodium glutamate also effect on heart histology of Wister rat as in figure 1,2,3,4 respectively.

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