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### Original Paper

## Assessment of Monosodium glutamate in some meat products.

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### ABSTRACT

Monosodium glutamate is an excellent flavor enhancer that can be found in a variety of foods. Its determination is crucial because it is linked to the sanitary quality of food and human health. This study aimed to assess monosodium glutamate (MSG) levels in some meat products collected from local markets in Cairo, Egypt. Fifty random samples of meat products were estimated by the HPLC-ultraviolet/diode array method. In general, there was no significant variations in MSG levels between samples ( $P > 0.05$ ). The highest mean  $\pm$  SE of MSG concentration (mg/gm) was found in chicken nuggets ( $3.95 \pm 0.51$ ) than in chicken burgers ( $1.85 \pm 0.28$ ). At the same time, beef sausage samples were the highest ( $2.75 \pm 1.05$ ), followed by beef burger ( $1.73 \pm 0.22$ ), and finally beef kofta ( $1.47 \pm 0.85$ ) mg/gm. of MSG. Fortunately, current estimated MSG contents in the examined products were less than the permissible limits set by EOS. More attention and strict regulations to reduce the risk of health hazards of these additives with accumulative exposure. Authorities must work together to determine the appropriate and safe levels of MSG in humans.

## 1. INTRODUCTION

Significant changes in the global meat industry have occurred in recent years, mostly because of worldwide population expansion. These facts might be one of the causes for the increased popularity of processed meat products such as canned and ready-to-eat meals.

The use of preservatives, flavor enhancers, and other additives in modern cuisine has become commonplace. Over a century ago, tasting salt, or monosodium glutamate, was created by the Japanese. The flavor profile known as Umami, which has a meaty flavor, is one of the most prevalent amino acids in nature. It finds in a heterogeneous group in a wide range of foods as a flavor enhancer (E621), either as hydrolyzed protein or as pure monosodium salt. (Zealand, 2003). MSG is also utilized as a food preservative due to its antioxidant properties (Mortensen *et al.*, 2017).

MSG is utilized in animal feed, food processing, restaurants, industries, and residences by both consumers and institutional food service providers. It may now be found in hundreds of foods all around the world, and its use is only growing. At the same time, during the previous two decades, health concerns regarding the products' widespread usage have surfaced. despite the fact that practically all legal regimes do not prohibit people from tasting salt. The Federation of American Societies for Experimental Biology (FASEB) reported in 1995 that MSG access in dosages ranging from 0.5 to 3 g can cause a transient MSG syndrome

(Chinese restaurant syndrome) (Singh, 2005). Various studies have hinted at possible toxic effects related to obesity, CNS disorders, and disruptions in adipose tissue physiology, CRS, hepatic damage, and reproductive malfunctions. (Niaz *et al.*, 2018). Furthermore, MSG is a controversial substance in terms of its harmful consequences following long-term dosing (Moldovan *et al.*, 2021). So, this work was designed to estimate the MSG in different meat products (chicken nuggets and burger and beef burger, sausage and kofta) sold in Egypt by using HPLC-UV/DAD. With regard to its significant contribution to human health.

## 2. MATERIAL AND METHODS

### 2.1. Collection of Samples:

A total of fifty random samples of frozen chicken nuggets and burger and beef burger, sausage and kofta (10 of each) were collected from local markets in Cairo, Egypt. The collected samples were preserved in an icebox then transferred to lab without undue delay and subjected to analyze MSG as follow: -

### 2.2. Monosodium glutamate in meat samples by using HPLC-UV/DAD (Soyseven *et al.*, 2021):

#### 2.2.1. Reagents and chemicals:

The HPLC grade water, analytical grade monosodium glutamate (MSG) reference standard from Sigma Aldrich company, hydrochloride acid (HCl), phthaldialdehyde powder (OPA), methanol (MeOH), diethylether, ophthalaldehyde-Ready to Use (OPA-RTU) reagent, 2-

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mercaptoethanol, Na<sub>2</sub>B<sub>4</sub>O<sub>7</sub>, and Na<sub>2</sub>HPO<sub>4</sub> (all of which were HPLC grade ultra-pure).

### 2.3. Preparation of stock solution of MSG:

In HPLC grade water at a concentration of 10 mg/ml from stock intermediate solution at a concentration of 1 mg/ml has been prepared. This intermediate solution was used in preparation of working standard in blank minced meat at concentration of 0.5, 1, 2, 5, 10, 20 mg/gm. then the spiked sample (working standard) was extracted and prepared as mentioned below.

### 2.4. Extraction of MSG from samples:

#### 2.4.1. Samples preparation:

Accurately, 1 g of the examined sample was homogenized with 100 mL of 0.10 N HCl solution. The resulting suspension was sonicated for 20 min. For extraction process, 50 mL of the prepared solution was taken over by adding 50 mL of diethyl ether and mixing thoroughly; then, the diethyl ether was removed. The MSG extraction approach was carried out using a previously published method by Croitoru *et al.* (2010). An extraction process was used to remove fatty acids. Each prepared sample was filtered through a 0.22 µm PVDF membrane filter and transferred to a vial after the aqueous phase was collected. All samples were derivatized with the OPA-RTU solution.

#### 2.4.2. Sample Derivatization:

To start, exactly 27 mg of OPA powder was added to 1 mL of HPLC grade MeOH and the mixture was stirred by vortex for 30 seconds to prepare the o-ph-thaldialdehyde (OPA) derivatizing agent. The mixture was then carefully added to 5 mL of mercaptoethanol solution. The OPA derivatization solution was then prepared by adding 9 mL of Na<sub>2</sub>B<sub>4</sub>O<sub>7</sub> buffer (0.10 M sodium tetraborate, pH = 9.30). (Zandy *et al.*, 2017). The OPA Ready to Use (OPA-RTU) solution (purchased from Sigma-Aldrich) was then used to derivatize MSG. Finally, both derivatizing solutions were used, and the same results were obtained. To save time and simplify each analysis, the OPA-RTU derivatization reagent was used instead of the OPA solution in the following experiments. (Demirhan *et al.*, 2015). For this reason, the OPA-RTU contains 1 mg of o-phthaldialdehyde per mL solution, with 2-mercaptoethanol serving as the sulphhydryl moiety. The 100 µL portions of the generated MSG working standard solution were taken and added to the HPLC vial, and 900 µL of OPA-RTU was added on every part, and the mixture was stirred well with vortex for five minutes. All standard working solutions were filtered through a 0.22 m PVDF membrane filter.

### 2.5. Apparatus and chromatographic condition:

HPLC device (Shimadzu, Nexera, I LC-2040C 3D model liquid chromatography, Japan) connected to a Shimadzu Nexera-I 2040C 3D Model UV/DAD detector. Chromatographic condition was carried out on a C18 column (Restek Raptor™) with a mobile phase of 10 mM phosphate buffer solution (PBS) (pH = 5.90): MeOH (75:25, v/v) at a flow rate of 0.6 mL/min. The injection volume was 20 µL, the needle was washed with water-MeOH (70:30, v/v), and the detection was performed at 336 nm.

### 2.6. Statistical Analyses:

A one-way variance analysis (ANOVA) was used to analyze the data using SPSS (version 20; IBM, Chicago, IL, USA). The difference at (P > 0.05) indicated no significant variation in MSG levels between samples.

## 3. RESULTS

### 1. Results for various meat products samples:

As shown in Table (1) and Fig. (1), results revealed that, the monosodium glutamate levels (mg/gm.) were varied in the examined meat products, chicken nuggets samples were the highest concentration levels in chicken products with a mean ± S.E value of (3.95 ± 0.51) in range of (3.02) to (4.8) followed by (1.85 ± 0.28) in range of (1.45) to (2.4) in chicken burger. Moreover, in beef products, beef sausage samples mean was (2.75 ± 1.05) in range of (0.78) to (4.38) followed by (1.73 ± 0.22) in range of (1.3) to (2) in burger and (1.47 ± 0.85) in range of (0.41) to (3.17) in kofta samples. On the other hand, the percentage of non-prescribed MSG on the labels were 30%, 30%, 0%, 0% and 0% in chicken nuggets, burger, beef sausage, burger and kofta, respectively as shown in Table (2).

Table 1 Monosodium glutamate values (mg/gm) of different examined meat products (n=10 of each).

Products	Minimum	Maximum	Mean ± S.E
Chicken Nuggets	3.02	4.81	3.95 ± 0.51
Chicken Burger	1.45	2.40	1.85 ± 0.28
Beef Sausage	0.78	4.38	2.75 ± 1.05
Beef Burger	1.30	2.00	1.73 ± 0.22
Beef Kofta	0.41	3.17	1.47 ± 0.85

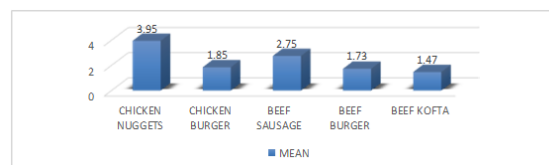


Figure 1 Mean values of Monosodium Glutamate (mg/gm) in different examined meat products.

Table 2 Prescribed and non-prescribed MSG values on labels of different examined meat products (n=10 of each).

Products	Prescribed on labels		Non-prescribed on label	
	No.	%	No.	%
Chicken Nuggets	7	70	3	30
Chicken Burger	7	70	3	30
Beef Sausage	10	100	0	0
Beef Burger	10	100	0	0
Beef Kofta	10	100	0	0
Total	44	88	6	12

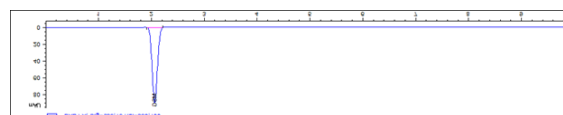


Figure 2 Chromatogram of MSG at a concentration of 20 mg/gm. In blank minced meat.

The calibration curve was created by plotting the areas of the analyst chromatograms against the concentration values of the MSG standard solutions. The mean values of the results obtained from three times repeated analyses of the standard solutions prepared in six different concentrations were used to achieve linearity.

The  $R^2$  value was determined to be 0.9999. The proximity of this value to one indicates that the correlation was satisfactory and applicable for this analytical method, as shown in Fig. (3).

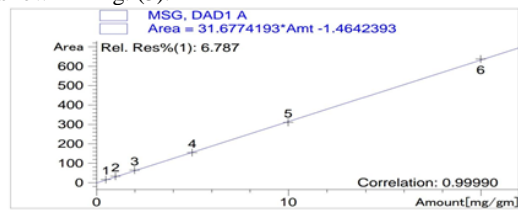


Figure 3 Standard curve of MSG area versus concentrations.

#### 4. DISCUSSION

Monosodium glutamate is one of the most popularly used taste enhancers in the food market, where its consumption has already been increasing, raising concerns about possible harmful effects. (Moldovan *et al.*, 2021). The food and drug administration (FDA) certified it safe for restricted use and noted some potential adverse effects associated with greater MSG use. Circulatory, cardiac, muscular, gastrointestinal, and neurological problems are more prevalent. (Kazmi *et al.*, 2017). Thus, MSG would be directly liable for genetic damage. It might alter the genetic material and, in turn, cause free radicals to cause harm by damaging the cell's nuclear component. (Imam, 2019).

According to the obtained results in Table (1), there were no significant variations in MSG values in the examined meat products. Whereas chicken nuggets had the highest concentration mean value of MSG, followed by beef sausage, chicken burger, beef burger, and beef kofta samples, and beef kofta samples had the lowest. In comparison with previous research, we found results of chicken nuggets were lower than that recorded by Sabikun *et al.* (2021) (210.8 mg/gm.). Also, beef burgers' mean values were higher than those detected by Rodriguez *et al.* (2003) (1.457 mg/gm.), (Afraa *et al.*, 2013) (1.6 mg/gm.) and (Hassan *et al.*, 2018) (1.399 mg/gm.). On the other hand, MSG in beef sausage samples was higher than the results illustrated by (Hassan *et al.*, 2018) (1.959 mg/gm) and (Baciu *et al.*, 2020) (0.178 mg/gm.) but lower than that recorded by Rohdes *et al.* (2015) (5.4 mg/gm.). Moreover, in beef kofta samples, MSG levels were lower than those recorded by both Hassan *et al.* (2018) (1.849 mg/gm.) and Soyseven *et al.* (2021) (21.3 mg/gm)

The amount of MSG in each product varies. Some have not been altered in terms of flavor. Moreover, the ideal concentration for its impact varies between individuals (Wijayasekara and Wansapala, 2017).

Monosodium glutamate must be included on the product packaging label, according to the FDA (Moldovan *et al.*, 2021). Given this concern and the current results of Table (2), about 12% of all the examined samples, including 30% of both chicken nuggets and burgers, contained MSG not prescribed on the label. These results disagreed with the recommendation of EOS (20<sup>16</sup>).

As a result, toxicity studies identified the No Observed Adverse Effect Level (NOAEL) level of 3200 mg of MSG/Kg bw (body weight/day) extrapolated from the Acceptable Daily Intake (ADI) dose (30 mg/Kg bw per day) according to official data from the European Food Safety Authority (EFSA) (Moldovan *et al.*, 2021). Previously,

JECFA attested to an ADI of MSG ranging from 0 and 120 mg/kg bw. (Mortensen *et al.*, 2017).

Although MSG's documented toxicity was minimal after short-term dosing (5000 mg/Kg bw/day) (EFSA, 2019) at long term consumption, because of the possibility of a cumulative component, knowledge concerning its influence on the organism is ambiguous. Unfortunately, there have been no limits to the amount of MSG that can be purchased. Furthermore, because daily MSG intake seems difficult to measure due to unknown levels of additives prevalent in fast food menus and processed foods, it can be very easy to reach the level of abusive usage. (Siddiqua, 2017 and Wijayasekara & Wansapala, 2017). Moreover, monosodium glutamate is a controversial substance when it comes to toxic effects following a long period of administration (Moldovan *et al.*, 2021).

#### 5. CONCLUSION

The highest concentration levels of MSG were in chicken nuggets and the lowest one was in beef kofta. On the other hand, because the dosage is not precisely and completely described, it is hard for a person to calculate the actual amount of MSG consumed. So, the food producers must be specifying the quantity on the label. International regulations require harmonization of safe doses of MSG based on more scientific studies.

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