" التأثير الوقائي المحتمل لأوراق البردقوش والريحان علي التسمم الكبدي المحدث بأحادي جلوتامات الصوديوم في الفئران "

إعداد

حبيبة محمد بسيونى أبو عيشة ، انصاف مختار ياسين ، سوزان سامي ابراهيم

كليه الاقتصاد المنزلي –قسم التغذية وعلوم الاطعمة –جامعه الازهر –مصر

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حبيبة محمد بسيونى أبو عيشة ، إنصاف مختار ياسين ، سوزان سامي إبراهيم

كليه الاقتصاد المنزلي –قسم التغذية وعلوم الاطعمة –جامعه الازهر –مصر

Email: habiba.m.abo3esha@gmail.com

مستخلص البحث:

يتم استهلاك الجلوتامات أحادية الصوديوم (MSG) كمُحسِّن للنكهة أو مضاف غذائي ولكن لها بعض الآثار الضارة على البشر وحيوانات التجارب. وأجريت الدراسة الحالية لدراسة التأثير الوقائي الكبدي لبعض الأعشاب (البردقوش والريحان) على أحادي جلوتامات الصوديوم في فئران التجارب. تم استخدام ستة وثلاثين ذكور جرذان ألبينو وزنها ١٣٠ ± ٢٠ جم في هذه الدراسة وتم تقسيمها إلى ست مجموعات رئيسية ، (٦ فئران لكل منهم) ، المجموعة الأولى مجموعة ضابطة سالبة وتم تغذيتها بالغذاء الأساسي طوال فترة التجربة (٣٨ يوم) . المجموعة الثانية تغذت على نظام غذائيًا أساسيًا لمدة ٢٨ يومًا ثم تم إعطاؤها يوميًا أحادي جلوتامات الصوديوم ٠,٦مجم / جرام من وزن الجسم) عن طريق الفم لمدة ١٠ أيام لاحداث التسمم الكبدي ، المجموعة الثالثة والرابعة تغذت على نظام غذائي أساسي يحتوي على مسحوق أوراق البردقوش (٥٪) و (١٠٪) على التوالي لمدة ٢٨ يومًا ثم تم إعطاؤها يوميًا أحادي جلوتامات الصوديوم ٠,٦مجم / جرام من وزن الجسم) عن طريق الفم لمدة ١٠ أيام. المجموعة الخامسة والسادسة تغذت على نظام غذائي أساسي يحتوي على مسحوق أوراق الريحان (٥٪) و (١٠٪) على

التوالي لمدة ٢٨ يومًا ثم تم إعطاؤها يوميًا أحادي جلوتامات الصوديوم ٠,٦مجم / جرام من وزن الجسم) عن طريق الفم لمدة ١٠ أيام. أظهرت النتائج أن أحادي جلوتامات الصوديوم في المجموعة الضابطة الموجبة (v +) أدت إلى زيادة الوزن النسبي للأعضاء ، وإنزيمات الكبد في الدم ، والكوليسترول الكلي والدهون الثلاثية ، LDL، VLDL ، المالون داي الدهيد وجلوكوز المصل ، بينما انخفضت نسبة BWG ، بروتينات المصل ، HDL في الدم ، سوبرأكسيد ديسميوتاز (SOD) ، والجلوتاثيون بيروكسيديز (GPx). أظهرت جميع المجموعات المعالجة بكلا النباتين تحسنا في المتغيرات السابقة مقارنة بالمجموعة المصابة الموجبة . وتوصي الدراسة الى امكانية استخدام الريحان والبردقوش (٥ و ١٠٪) لتحسين وظائف الكبد وحماية الكبد من الإجهاد التأكسدي الناجم عن أحادي جلوتامات الصوديوم.

الكلمات المفتاحية: التسمم الكبدي–الانزيمات المضادة للأكسدة– وظائف الكبد– الفحص الهستوباثولوجي .

Potential protective effect of marjoram and basil leaves against monosodium glutamate induced hepatotoxicity in rats.

Habiba Mohamed Bassioni Aboshia, Ensaf M.Yassin and Suzan S. Ibraheim

Nutrition and Food Science Department, Faculty of Home Economics, Al-Azhar University, Egypt

ABSTRACT

Monosodium glutamate (MSG) is consumed as a flavor enhancer or food additive but it have some adverse effects on humans and experimental animals. The present study was carried out to investigate the hepatoprotective effect of some herbs (marjoram and basil) on MSG in experimental rats. Thirty-six male albino rats weighing 130 ± 20 g were used in this study and divided into six main groups, (6 rats each),Group (1), as a negative control group (-v) received a basal diet throughout the experiment period, (for 38 days) while group (2):as a positive control group (+v) received a basal diet for 28 days and then administered daily MSG (0.6 mg/g body wt.) by gavage for 10 days to induce hepatotoxicity, group (3) and group (4) : received a basal diet containing marjoram leaves powder (5%) and (10 %) ,respectively for 28 days and then administered daily to MSG (0.6 mg/g body wt.) by gavage for 10 days, group (5) and group (6) : received a basal diet containing basil leaves powder (5%) and (10%) ,respectively for 28 days and then administered daily to MSG (0.6 mg/g body wt.) by gavage for 10 days. The results revealed that MSG in the (v +) control group increased relative organ weight, serum liver enzymes, total cholesterol and triglycerides, LDL,VLDL, MDA and serum glucose, while decreased in BWG%, serum proteins ,serum HDL, serum Superoxide Dismutase (SOD), and Glutathione Peroxidase (GPx). All treated groups with two plants showed improvement in previous parameters compared with the positive control group. In conclusion, the consumption of basil and marjoram (5 and 10%)

could be used for improving liver function and protecting the liver from oxidative stress induced by monosodium glutamate.
Keywords: Hepatotoxicity –Antioxidant enzymes- Liver functions -Histopathological examination.

INTRODUCTION

Monosodium glutamate (MSG) is a sodium salt of glutamic acid. MSG has a distinctive taste that falls outside the region of the four classic tastes: sweet, sour, salty, and bitter. Due to this special taste, many food producers use MSG to enhance the flavor of their products **(Augustine *et al.*, 2019).**

The liver is a vital organ that plays a major role in the body. The liver tolerates maximum insult in detoxifying the various toxins present in the food, drinks, drugs and environment (**Reema *et al.*, 2018).** In a previous study that investigated the potential of low concentration administration of MSG in inducing hepatotoxicity in male albino rats, it was observed that treating rats with monosodium glutamate at a low concentration (5mg/kg of body weight) could be hepatotoxic without significant cholestasis or pathologies of the bone **(Augustine *et al.*,2019).**

There is an increased demand for using medicinal plants in therapy, due to the growing recognition of natural products, instead of using synthetic drugs which might have adverse effects **(Abdel-Tawab *et al.*, 2013).**

Marjoram (*Origanum majorana* L.) is a member of the mint family Lamiaceae. In folk medicine, marjoram is used for cramps, depression, dizziness, gastrointestinal disorders, migraine, nervous headaches, and paroxysmal coughs and as a diuretic. It contains phenolic terpenoids (thymol, carvacrol), flavonoids (diosmetin, luteolin, and apigenin), tannins, hydroquinone, phenolic glycosides (arbutin, methyl arbutin, vitexin, and orientinthymonin), triacontane, sitosterol, acids (oleanolic acid), and cis-sabinene hydrate **(Abdel-Tawab *et al.*, 2013).**

Basil *(Ocimum basilicum)* is an annual herb of the Lamiacea*e* family and is widely used in folk medicine to treat a

wide range of diseases and has numerous pharmacological activities. Basil possesses high power against oxidation . The antioxidative effect of basil is mainly due to its content of phenolic components, such as flavonoids, phenolic acids, rosmarinic acid and aromatic compounds .Additionally, basil had been found to contain linalool, eugenol, methyl chavicol, methyl cinnamate, ferulate, methyl eugenol, triterpenoids and steroidal glycoside known to exhibit antioxidant, chemopreventive, anti-inflammatory, bactericidal, antiulcer activities and a nervous system stimulant effect **(Mohammed and Atef 2019).** So this study was carried out to investigate the hepatoprotective effect of some herbs (marjoram and basil) on MSD in experimental rats.

MEATERIALS AND METHODS

Plant materials: dried marjoram and basil leaves were purchased from the Local Company for Herbs and Medicinal Plants, Cairo Governorate, Egypt.

Experimental animals: A total of 36 adult male albino rats (Sprague Dawley strain) were obtained from the animal colony, Helwan farm, Vaccine and Immunity Organization, Ministry of Health, Cairo Governorate, Egypt.

Chemicals: All required chemicals were obtained from Elgomhouria Company for Trading Drugs, Chemicals and Medical Appliances, Cairo, Egypt.

Plant sample preparation: dried marjoram and basil leaves were homogenized in the blender, and then stored at room temperature in closed glass bottles in the dark until used.

Experimental diets: basal diet was prepared according to **Reeves *et al*., (1993).**

Experimental design: Animals were kept in clean wire cages under hygienic conditions. Feed will be introduced (*ad libitum*) to the rats in special food containers to avoid scattering. Similarly, fresh water will be provided *ad-libitum* and checked daily. Adaptation continued for one week. After that, rats were randomly

assigned to (6) equal groups as follows, the first was the (v -) control group which fed on a basal diet for 38 days, the second was the (v +) control group which fed on a basal diet for 28 days then administered daily to MSG (0.6 mg/g body wt.) by gavage for 10 days to induce hepatotoxicity **(Onyema *et al*,. 2006)** (MSG will dissolve in water at a concentration of 120 mg/ml). The third and fourth given basal diet supplemented marjoram leaves powder (5%) and (10%), respectively for 28 days as a protective agent then administered daily to MSG (0.6 mg/g body wt.) by gavage for 10 days . The five and sixth given basal diet supplemented basil leaves powder (5%) and (10%), respectively for 28 days as a protective agent then administered daily to MSG(0.6 mg/g body wt.) by gavage for 10 days .

Meanwhile during the experiment, body weight and feed intake were checked once a week. In the end, animals were weighed, fasted overnight, and then sacrificed under very light ether anaesthesia. Blood samples were collected from the hepatic portal vein of each rat into dry clean centrifuge tubes. Serum was carefully separated by centrifugation of blood samples at 3500 rpm (round per minute) for 15 minutes at room temperature, transferred into dry clean Eppendorf tubes, then kept frozen at -20˚C. Livers, kidneys and hearts were removed from rats by careful dissection, washed in saline solution (0.9%), dried using filter paper and independently weighed.

Biological Evaluation

Feed intake was recorded every day for the duration of the experiment (38 days), and body weight was measured every week. Body weight gain percent (BWG percent) and feed efficiency ratio (FER) were calculated according to **Chapman *et al.*, (1959).**

Biochemical analysis of serum

Serum was analyzed for various biochemical parameters like Aspartate aminotransferase (AST), Alanine aminotransferase (ALT), and Alkaline phosphatase (ALP) were measured according to **Bergmeyer *et al.*, (1986) and Roy (1970).** Total protein estimated by Biuret reaction as described by **Sonnenwirth and Jaret (1980).** Albumin was determined according to the

method described by ***Drupt, (*1974)** as modified after **spencer and price (1977) by** using the Diamond company kit. Serum globulin was calculated according to **Chary and Sharm (2004)**. Serum Alb / Glb ratio was calculated according to **Srivastava *et al.*, (2002)**. Lipid profile, Total cholesterol, Triglycerides and HDL-C were evaluated on the authority of **Allain *et al.*, (1974)**, **Trinder &Ann (1969)** and **Lopes -Virella *et al.*, (1977)** but LDL-C and VLDL-C were calculated according to **Friedwald *et al.*, (1972)**. The concentration of glucose in the blood was determined using the method outlined by **Trinder (1959).** Antioxidant enzymes superoxide dismutase (SOD), glutathione peroxidase (GPx) and Malondialdehyde (MDA) level as a parameter for lipid peroxidation were determined according to **Kakkar *et al.*, (1984)**, **Ellman (1959) and Draper *et al.*, (1993).**

Histopathological Examination

The liver was promptly fixed in 10% buffered neutral formalin. Following that, the fixed tissues were processed for histopathological tests as described by **Carleton (1979).**

Statistical analysis

The average and standard deviation are used to express the results. The significance of differences in means between groups was examined using a one-way analysis of variance (ANOVA) followed by Duncan's test, with a probability value of 0.05 or less considered significant. The least significant differences test (LSD) was used to compare mean values according to **Sendcor and Cochran (1979)** using SPSS (version 20).

RESULTS

Table (1) showed the total phenolic and total flavonoid contents in basil and marjoram, The amount of total phenolic compounds in basil and marjoram were (0.87 and 0.86% ,respectively). While the amount of total flavonoids in basil and marjoram were (0.24 and 0.25 mg/100g, respectively).

Table (2): showed the averages (g) of moisture, protein, fat, carbohydrates and ash (g/100mg) in basil and marjoram powder. The results of chemical compositions for basil powder revealed that carbohydrates recorded the highest average (61.93) followed by moisture (14.40), protein (11.5), lipids (5.83), ash (3.56), and fibers (2.78), respectively. While, the results of chemical compositions for marjoram powder revealed that carbohydrate recorded the highest average (59.45) followed by moisture (12.81), protein (11.06), ash (5.78), lipids (5.66) and fibers (5.24), respectively.

Table (3): showed the effect of marjoram, (5%and 10%), and basil (5% and 10 %) on feed intake (FI), body weight gain (BWG %) and feed efficiency ratio (FER) against monosodium glutamate (MSG) induced hepatotoxicity in rats. The results showed that previously mentioned parameters recorded a decrease in the positive control group as compared to a negative control group. All the treated groups with marjoram and basil (5%, 10%) showed a significant increase ($P<0.05$) as compared to the positive control group.

Table (4): showed the effect of marjoram (5% and 10%) and basil (5% and 10%) on relative organs weight against monosodium glutamate (MSG) induced hepatotoxicity in rats. Relative heart and kidney weight values showed a significant increase in the positive control group as compared to the negative control group. All treated groups indicated a significant decrease as compared to the positive control group. The best result was found in the treated group with (basal 10 %) and closed to the normal group.

Table (5): showed the effect of marjoram (5% and 10%), and basil (5 % and 10 %) on liver enzymes on hepatotoxicity in rats. Serum aspartate transaminase (AST) value showed a significant increase in the positive control group as compared to the negative control group. As shown in table (5) all treated groups indicated a significant decrease in AST as compared to the positive control group. The best result was found in the treated group with

(marjoram 10%) and closed to the normal group. Also, the mean value of serum alanine transaminase (ALT) and alkaline phosphatase (ALP) showed a significant increase in the positive control group as compared to the negative control group. All treated groups recorded a significant decrease in the previous parameters as compared to the positive control group. Also the mean value of serum AST/ALT ratio showed a significant decrease in the positive control group as compared to the negative control group. The best result was found in the treated group with marjoram (10%) and basil (10 %) and closed to the normal group.

Table (6): showed the effect of marjoram (5% and 10%), and basil (5 % and 10 %) on serum proteins on hepatotoxicity in rats. Total protein (TP), albumin (Alb) and globulin (Glb) values showed a significant decrease in the positive control group as compared to the negative control group. All treated groups indicated a significant decrease as compared to the negative control group. The best result was found in the treated group with (marjoram 10%) and closed to the normal group. Also the best result with albumin and globulin was found in the treated groups with marjoram (10%) and basil (10%) as shown in table (6). While the mean value of serum A/G ratio showed a significant increase in the positive control group as compared to the negative control group. All treated groups indicated a significant increase as compared to the negative control group. The best result was found in the treated group with marjoram (10%) and closed to the normal group.

Table (7) showed the effect of, marjoram (5% and 10%), and basil (5% and 10%) on Total cholesterol (T.C) and Triglycerides (T.G) on hepatotoxicity in rats. The result revealed that, a significant increase in total cholesterol and triglyceride in the positive control group as compared to the negative control group. While, these parameters decreased in all treated groups especially the treated group with (marjoram 10%) which showed the best result and was closed to the normal group as shown in table (7).

Table (8) Showed the effect of marjoram (5% and 10%), and basil (5% and 10%) on lipid profile (HDL, LDL, VLDL) on hepatotoxicity in rats. The result revealed that, a significant decrease in (HDL) in the positive control group as compared to the negative control group. While, this parameter (HDL) recorded a significant increase in the treated groups with marjoram (10%), and basal (10%) as compared to the positive control group. On the other hand, (LDL&VLDL) parameters recorded a significant increase in the positive control group as compared to the negative control group While, these parameters decreased in all treated groups especially the treated group with (marjoram 10%) which recorded the best result and closed to the normal group as shown in table (8).

Table (9) showed the effect of marjoram (5%, 10%) and basil (5%, 10%) on serum glucose on hepatotoxicity in rats. Serum glucose showed a significant increase in the positive control group as compared to the negative control group (114.17 ± 9.85 and 90.83 ± 14.18 mg/dl, respectively). All treated group indicated a significant decrease as compared to the positive control group. The best result was found in the treated groups with basal (10%) & (marjoram 10%) and closed to the normal group as shown in table (9).

Table (10) showed the effect of marjoram (5% and 10%), and basil (5 % and 10 %) on serum antioxidant enzymes on hepatotoxicity in rats. The mean value of SOD and GPx value showed a significant decrease in the positive control group as compared to the negative control group. All treated groups indicated a significant increase as compared to the positive control group. The best result was found in the treated groups with marjoram (10%), followed by basil (10). While, value of MDA showed a significant increase in the positive control group as compared to the negative control group. All the treated groups indicated a significant decrease ($P<0.05$) as compared to the positive control group. The best result was found in the treated groups with marjoram (10%) followed by basil (10%), as shown in table (10).

Total phenolic, total flavonoid contents

Table (1): Total phenolic, total flavonoid contents in basil and marjoram.

Herbs	Total phenols (%)	Total Flavonoids (mg/100g)
Basil	0.87 ± 0.02	0.24 ± 0.02
Marjoram	0.86 ± 0.11	0.25 ± 0.02

Table (2): The averages of moisture, protein, fat, carbohydrate and ash (g/100g) in basil and marjoram powder.

Proximate composition(g/100g)	Basil	Marjoram
Total carbohydrate %	61.93 ± 0.02	59.45 ± 0.15
protein	11.5 ± 0.02	11.06 ± 0.17
Lipids %	5.83 ± 0.02	5.66 ± 0.21
Moisture %	14.40 ± 0.11	12.81 ± 0.09
Fibers%	2.78 ± 0.18	5.24 ± 0.10
Ash %	3.56± 0.10	5.78 ± 0.21

Biological evaluation:

Table (3): Effect of diets supplemented with basil and marjoram on total feed intake, feed efficiency ratio and BWG% on hepatotoxicity in rats (n=6rat)

parameters / Groups	FI (g/day)	BWG %	FER
Control –ve	18.67 ± 1.51 ^{a}	42.73 ± 3.25 ^{a}	0.086 ± 0.003 ^{a}
Control +ve	13.67 ± 0.82 ^{c}	30.95 ± 3.27 ^{d}	0.049 ± 0.003 ^{e}
Marjoram (5%)	16.17 ± 0.75 ^{b}	35.56 ± 4.62 ^{bcd}	0.056 ± 0.004 ^{cd}
Marjoram 10%	18.17 ± 1.17 ^{a}	39.31 ± 5.63 ^{ab}	0.061 ± 0.006 ^{ab}
Basal 5 %	16.67 ± 1.37 ^{b}	32.97 ± 3.69 ^{cd}	0.05 ± 0.003 ^{d}
Basal 10 %	18.33 ± 0.82 ^{a}	37.29 ± 5.18 ^{bc}	0.059 ± 0.004 ^{bc}
LSD	1.31	5.1596	0.0047

Each value represents the mean (n=5) ±SD. Means in the same column with different superscript letters are significantly different at $p \leq 0.05$

Table (4): Effect of diets supplemented with basil and marjoram on relative organs weight on hepatotoxicity in rats (n=6rat)

Parameters / Groups	Relative organs weight (g/100 g. B.Wt.)		
	Liver	Kidney	Heart
Control -ve	3.38 ± 0.28 ^{d}	0.74 ± 0.12 ^{b}	0.29 ± 0.04 ^{d}
Control +ve	4.82 ± 0.39 ^{a}	0.98 ± 0.24 ^{a}	0.40 ± 0.03 ^{a}
Marjoram 5%	4.18 ± 0.39 ^{bc}	0.90 ± 0.19 ^{ab}	0.34 ± 0.03 ^{bc}
Marjoram 10%	3.66 ± 0.46 ^{cd}	0.81 ± 0.10 ^{ab}	0.31 ± 0.02 ^{cd}
Basal 5 %	4.27 ± 0.81 ^{ab}	0.83 ± 0.14 ^{ab}	0.36 ± 0.04 ^{b}
Basal 10 %	3.38 ± 0.28 ^{d}	0.77 ± 0.11 ^{b}	0.30 ± 0.03 ^{d}

LSD	0.5559	0.18455	0.0389

Each value represents the mean (n=5) ±SD. Means in the same column with different superscript letters are significantly different at $p \leq 0.05$

Table (5): Effect of diets supplemented with basil and marjoram on serum liver enzymes on hepatotoxicity in rats (n=6rat)

parameters / Groups	ALT(U/L)	AST(U/L)	ALP(U/L)	AST/ALT Ratio
Control -ve	23±5.76 ^{c}	95.67 ± 15.51 ^{e}	312.7 ± 23.54 ^{c}	4.25± 0.50 ^{a}
Control +ve	50.83±10.27 ^{a}	183.3 ± 19.67 ^{a}	482.8 ± 59.53 ^{a}	3.71± 0.75 ^{ab}
Marjoram 5%	37.17± 6.18 ^{bc}	141.5 ± 17.36 ^{bc}	356 ± 35.12 ^{c}	3.83± 0.183 ^{ab}
Marjoram 10%	27.33± 6.31 ^{d}	111± 19.45 ^{de}	312.7 ± 29.47 ^{c}	4.13± 0.43 ^{a}
Basal 5 %	43.17± 5.64 ^{ab}	152 ± 16.48 ^{b}	405.8 ± 38.00 ^{b}	3.53± 0.18 ^{ab}
Basal 10 %	31.67±7.45 ^{cd}	130 ± 17.37 ^{cd}	338.5 ± 30.60 ^{c}	4.19± 0.44 ^{a}
LSD	8.39	20.88	44.59	0.54

Each value represents the mean (n=5) ±SD. Means in the same column with different superscript letters are significantly different at $p \leq 0.05$

Table (6): Effect of diets supplemented with basil and marjoram on serum Protein status and the ratio between Alb/Glb on hepatotoxicity in rats (n=6rat)

Parameters / Groups	TP (g/dl)	Alb (g/dl)	Glb (g/dl)	A/G ratio
Control -ve	6.67 ± 0.20 ^{a}	4.33 ± 0.12 ^{a}	2.64 ± 0.14 ^{a}	1.64± 0.05 ^{c}
Control +ve	4.62 ± 0.33 ^{e}	3.42 ± 0.24 ^{e}	1.15 ± 0.28 ^{d}	3.08± 0.51^{a}
Marjoram 5%	5.79 ± 0.26 ^{c}	3.86 ± 0.21 ^{cd}	1.87 ± 0.11^{c}	2.07± 0.06 ^{b}
Marjoram 10%	6.42 ± 0.18 ^{ab}	4.16 ± 0.15 ^{ab}	2.36 ± 0.21^{b}	1.77± 0.10 ^{c}
Basal 5 %	5.39 ± 0.39 ^{d}	3.71 ± 0.28 ^{d}	1.80 ± 0.24 ^{c}	2.08± 0.14 ^{b}

Basal 10 %	6.31 ± 0.21 ^{b}	4.02 ± 0.20 ^{bc}	2.19 ± 0.23 ^{b}	1.85± 0.10 ^{bc}
LSD	0.32	0.25	0.25	0.27

Each value represents the mean (n=5) ±SD. Means in the same column with different superscript letters are significantly different at $p \leq 0.05$

Table (7): Effect of diets supplemented with basil and marjoram Total cholesterol and Triglycerides on hepatotoxicity in rats (n=6rat)

parameters / **Groups**	**total cholesterol** (mg/dl)	**Triglycerides** (mg/dl)
Control -ve	52.50 ± 4.42 ^{e}	68.83 ± 6.05 ^{e}
Control +ve	96 ± 8.20 ^{a}	107.67 ± 10.93 ^{a}
Marjoram 5%	77 ± 7.32 ^{c}	86.33 ± 5.82 ^{c}
Marjoram 10%	57.33 ± 6.47 ^{de}	75.00 ± 3.58 ^{de}
Basal 5 %	87.33 ± 5.82 ^{b}	96.33 ± 10.05 ^{b}
Basal 10 %	64.83 ± 8.50 ^{d}	78.83 ± 7.33 ^{cd}
LSD	8.17	9.10

Each value represents the mean (n=5) ±SD. Means in the same column with different superscript letters are significantly different at $p \leq 0.05$

Table (8): Effect of diets supplemented with basil and marjoram on lipoprotein fractions on hepatotoxicity in rats (n=6rat).

Parameters / Groups	HDL (mg/dl)	LDL (mg/dl)	VLDL (mg/dl)
Control –ve	36.83 ± 4.22 ^{ab}	1.90 ± 0.80 ^{e}	13.77 ± 1.21 ^{e}
Control +ve	24.33 ± 2.25 ^{d}	50.27 ± 7.55 ^{a}	21.53 ± 2.19 ^{a}
Marjoram 5%	33 ± 3.22 ^{bc}	26.73 ± 3.72 ^{c}	17.27 ± 1.16 ^{c}
Marjoram 10%	40 ± 6.26 ^{a}	2.33 ± 0.37 ^{e}	15 ± 0.72 ^{de}
Basal 5 %	28.67 ± 1.86 ^{cd}	39.40 ± 5.22 ^{b}	19.27 ± 2.01 ^{b}
Basal 10 %	41.33 ± 6.06 ^{a}	7.73 ± 1.92 ^{d}	15.77 ± 1.47 ^{cd}
LSD	5.12	4.88	1.82

Each value represents the mean (n=5) ±SD. Means in the same column with different superscript letters are significantly different at $p \leq 0.05$

Table (9): Effect of diets supplemented with basil and marjoram on serum glucose on hepatotoxicity in rats (n=6rat)

Parameters / Groups	Serum glucose (mg/dl)
Control -ve	90.83 ± 14.18 ^{b}
Control +ve	114.17 ± 9.85 ^{a}
Marjoram 5%	103.83 ± 13.41 ^{ab}
Marjoram 10%	91.33 ± 20.51 ^{b}
Basal5 %	106.67 ± 12.31 ^{ab}
Basal 10 %	90.17 ± 23.43 ^{b}
LSD	19.25

Each value represents the mean (n=5) ±SD. Means in the same column with different superscript letters are significantly different at $p \leq 0.05$

Table (10): Effect of diets supplemented with basil and marjoram on SOD, GP_X and MDA on hepatotoxicity in rats (n=6rat)

Parameters / Groups	SOD (U/L)	GPX (ng/ml)	MDA (m mol /gm)
Control -ve	81.47±8.42 [a]	125.57± 15.51[a]	4.17± 0.77 [d]
Control +ve	38.67±4.15 [d]	66.40± 19.67 [e]	16.64± 2.50 [a]
Marjoram 5%	57.03± 6.91 [c]	98.20± 17.36 [c]	8.93± 1.70 [c]
Marjoram 10%	75.30± 8.56 [ab]	113.30± 19.45 [b]	5.84± 1.16 [d]
Basal 5 %	49.13± 7.14 [c]	87.67 ± 16.48 [d]	11.57± 1.80 [b]
Basal 10 %	69.83±5.78 [b]	101.77 ± 17.37 [c]	7.92±1.83 [c]
LSD	8.25	9.26	2.02

Each value represents the mean (n=5) ±SD. Means in the same column with different superscript letters are significantly different at $p \leq 0.05$

Histopathological results:

Microscopic pictures of H&E stained liver sections of rats from the control –ve group showed normally arranged hepatic cords around central veins (CV) with normal portal areas (PA) and sinusoids (Photo 1,2). However, sections from the control +ve group revealed a loss of normal arrangement of hepatic cords, fibrous tissue strands extending from portal areas (thick arrows), with the presence of hemosiderin-laden macrophages (arrowheads). (Photo 3, 4). The liver of rats treated with basil (5%) showed normal arrangement and appearance of hepatocytes around CV with a mild expansion of the portal area due to mild collagen deposition (thick black arrow) (Photo 5). Moreover, the

liver of rat treated with basil (10%) revealed normal arrangement of hepatocytes around CV with mild periportal hydropic degeneration in hepatocytes (thin black arrow) without collagen deposition (photo 6). Normal arrangement of hepatic cords with few cytoplasmic vacuolations in hepatocytes (arrowheads) around CV, mild periportal hydropic degeneration in hepatocytes (thin black arrow) without collagen deposition in liver of rats treated with marjoram(5%)(Photo7). Also, normal arrangement of hepatocytes around CV with periportal minute cytoplasmic vacuolations in hepatocytes (arrowheads) without collagen deposition in liver of rats treated with marjoram (10%) (Photo 8).

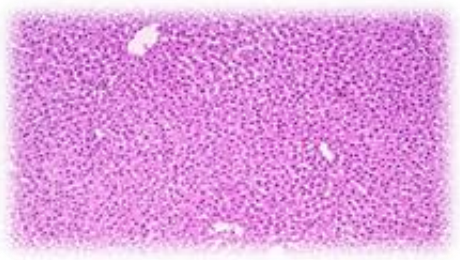	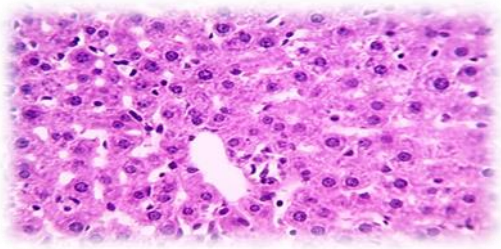
Photo (1): Liver of rat from control –ve normal group showing the arranged hepatic cords around central veins (CV) with normal portal areas.	**Photo (2):** Liver of rat from control –ve normal group showing normally arranged hepatic cords around central veins (CV) with normal portal areas and sinusoids**.**
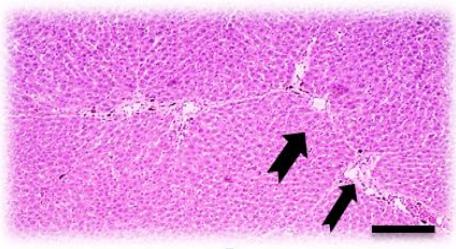	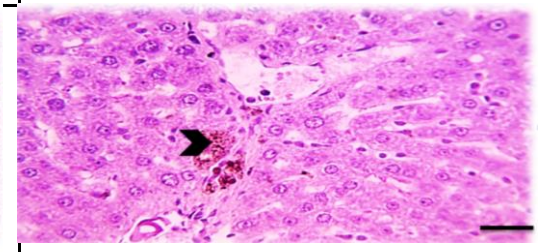
Photo (3): Liver of hepatointoxicated rat (control +ve group) showing loss of normal arrangement of hepatic cords, fibrous tissue strands extending from portal areas.	**Photo (4):** Liver of hepatointoxicated rat (control +ve group) showing fibrous tissue strands extending from portal areas, with presence of hemosiderin laden macrophages

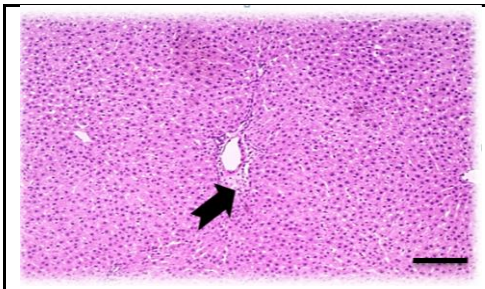	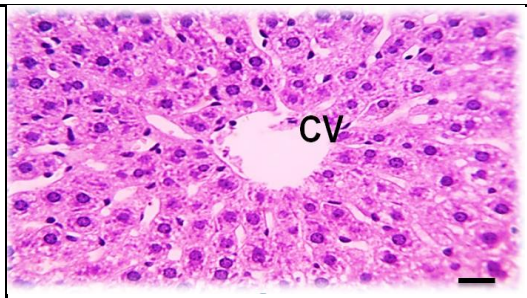
Photo (5): Liver of hepatointoxicated rat fed on basil (5%) showing normal arrangement and appearance of hepatocytes around CV with mild expansion of portal area due to mild collagen deposition.	**Photo (6):** Liver of hepatointoxicated rat fed on basil (10%) showing normal arrangement of hepatocytes around CV with mild periportal hydropic degeneration in hepatocytes without collagen deposition.
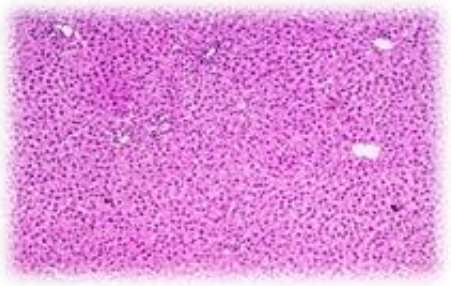	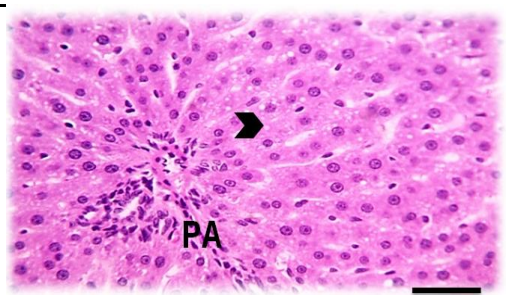
Photo (7): Liver of hepatointoxicated rat fed on marjoram (5%) showing normal arrangement of hepatic cords with few cytoplasmic vacuolations in hepatocytes (arrowheads) around CV.	**Photo (8):** Liver of hepatointoxicated rat fed on marjoram (10%) showing normal arrangement of hepatocytes around CV with periportal minute cytoplasmic vacuolations in hepatocytes without collagen deposition.

Discussion

Monosodium glutamate intake associated with multiple deleterious effects. The determination of agents with a strong protective role against their health hazards with the potential natural occurrence and broad safety window represents a field of growing interest (**Abd-Elkareem *et al.*,2022**) .

Our results are in line with **Ragab *et al.*, *(*2015)** who reported that the amount of phenolic compounds in marjoram was 0.79g of GAE/100g. ,while the mount of flavonoids (8.14 mg) was the highest. Also, **Andarwulan *et al.*,(2010),** found that fresh basil leaves contain phenol compounds as much as 0.812±0.119 mg GAE/g and a total flavonoid of 7.22±0.36 mg/100 g. The antioxidant activity of components in sweet basil could be clarified the importance of its anti-oxidative effectiveness as approved by **EL-Gammal (2017).** In the present study, the results revealed that the chemical compositions for basil and marjoram powder showed that carbohydrates recorded the highest average, according to **El- Gammal (2017)**. Moreover, **Badawy and Arafa (2021)** assessed the moisture, protein, fat, ash, fiber and available carbohydrates contents of snacks control and incorporated snacks with different levels of marjoram (2.5, 5 and 7.5 %). The control snack had 10.12% moisture, 8.18 % protein, 1.70 % crude fat, 1.38 % ash, 1.11 % crude fiber and 87.22 % available carbohydrates, according to the results. In addition, the moisture, Protein, crude fat, ash, and crude fiber content of snacks containing marjoram powder increased as the percentage of marjoram increased significantly. The marjoram herb had high protein, ash, and fiber content of 11.2, 29.0 and 18.5 %, respectively.

In this study, the results showed that FI, BWG% and FER recorded a decrease in the positive control group as compared to a negative control group. These results agree with **Onaolapo *et al.*,**

(2017) assessed the administration of MSG by gavage was associated with dose and time-related alterations in open field spontaneous locomotor activity, rearing and self-grooming .The results showed that administration of MSG was associated with a decrease in rearing, dose-related mixed horizontal locomotor, grooming and anxiety-related response and an increase in brain glutamate/glutamine levels. While, **Abd Allah(2021)** demonstrated that groups that received MSG revealed a significant increase in feed intake (FI) from control group, while the treatments with the different doses of Spirulina in MSG+ Sp groups (0.5, 1 and 2 %) recorded a highly significant decreases in the BWG% and FI when compared to the MSG-group alone. As for feed efficiency ratio (FER) the results revealed insignificant changes in all groups. **Also, Boutry *et al.*, (2011)** reported that no significant differences were found between C and MSG-C groups for initial and final weight and weight gain. Feed intake and feed efficiency ratio (weight gain/energy ingested) were not significantly affected by MSG supplementation. In addition these results are in accordance with El **Gamel *et al.*,(2019)** revealed no significant change in feed intake among all tested diets. Also, after feeding, the experimental animal with different tested diets, the rats' BWG (g/day) was calculated and the results are shows an increase in the means of FER and BWG in all groups compared to the control group although the increase was not significant. On the other hand**, Abbas *et al.*, (2016)** investigated the effect of some marjoram and its extracts on liver cancer incidents by Benzopyrene in Rats. The obtained results revealed that feeding on marjoram and its extracts caused a significant ($P \leq 0.05$) improvements in body weight gain (BWG %), FER. It may be due to the chemical compositions of marjoram leaves and lots of esters like in marjoram oils containing have a bactericidal activity, it inhibits the growth of microorganisms , improves the final weight, weight gain and FER in liver injured groups which treated with

marjoram leaves as approved **by Abd El-Ghany and El-Metwally (2010).** Also, **Kiyose *et al* ., (2021)** determined if there are anti-inflammatory and anti-obesity effects of sweet basil, an herb, in mice. They found that the body weight loss caused by intake of sweet basil powder did not appear to depend on the feed intake. Therefore, there was no an anti-obesity effect from sweet basil powder intake.

The obtained findings, relative liver, heart and Kidney weight value showed a significant increase in the positive control group as compared to the negative control group. These results are in agreement with **Tawfik *et al* .,(2012)** who reported that there are a significant increase in the liver and kidney weight of the rats was observed after administration of MSG at two employed doses . Thus, could be attributed to an increase in the activity of inflammatory agents that could have resulted to inflammation of liver and kidney tissues. Also, our result is in line with **Ezeokeke *et al* .,(2017)** showed the effect of MSG, vitamin E and MSG+ vitamin E on the liver and kidney weights of the male albino rats. There was a significant difference ($P<0.05$) in the liver and kidney weights of the rats treated with MSG groups of the liver and the kidney when compared with the control group. The changes in relative liver and kidney weights have been accompanied with changes in functional aspects. In addition to, **Tchaou *et al.*, (2013)** who explained the final body weight, the body weight gain and the relative heart weight did not differ in the groups. Relative intra-abdominal fat deposition (mesenteric, retroperitoneal and epididymal fat) and relative liver weight were markedly higher in MSG-HF and MP-HF treated groups compared to the control group. In addition, **Hassanen(2012))** investigated the hepatoprotective effect of marjoram against carbon tetrachloride intoxication in rats compared with drug (25mg/kg diet). The results concluded that there were decreased significant differences

in liver, kidney, heart and spleen relative organs weight in rats fed on marjoram in rats. Also **Hikal *et al* .,(2018)** explained that final body weight is decreased in CCl_4 intoxicated group compared to the normal control group and it significantly increased in the intoxicated group treated with marjoram and/ or silymarin as compared to the intoxicated group. Also, the major finding of this study is that there are a significant increase ($P \leq 0.05$) in absolute and relative liver weights of (G2) CCl4 intoxicated group compared to normal control. On the other hand, there are no significant changes in other groups as compared to the normal control group except for (G5) intoxicated group treated with marjoram compared to the normal group. Moreover, our result are in line with **El-Hashash (2019)** reported the nutritive value of sweet basil leaves and investigate their effects as a functional food on CCl_4-intoxicated rats previously fed on high fat diet as a novel nonalcoholic fatty liver disease (NAFLD) model. The results showed that the relative liver weight decreased significantly in the group fed on the high concentration of SBLP (sweet basil leaves powder 4 %). Also, **Umar *et al* .,(2010)** demonstrated that the heart weight/body weight ratio was markedly lower in the captopril and *Ocimum basilicum L*. OBL groups than that in the untreated hypertensive group . The values in the OBL groups showed dose dependence. The heart weight to body weight ratio in the highest dose group for OBL was not different from that of the sham-operated normotensive rats. Also **Harnafi *et al* .,(2009)** investigated the effect of an experimental diet and sweet basil consumption on organ and body weights. During the feeding period, there were no significant differences in relative organ liver, heart and Kidney weight between all dietary groups. Animals on the experimental diets appeared healthy and any pathological or toxicological sign was noted indicating that the diets given were adequate. It may be due to the anti-inflammatory effect of basil as concluded by **Shahrajabian et al., (2020).**

The current investigation indicated that serum aspartate transaminase (AST) value showed a significant increase in the positive control group as compared to the negative control group. . Also, the mean value of serum alanine transaminase (ALT) and alkaline phosphatase (ALP) showed significant increase in positive control group as compared to negative control group. All treated groups recorded a significant decrease in previous parameters as compared to positive control group. The liver has a significant role in metabolism, regulation of red blood cells (RBCs) and glucose synthesis and storage. The liver function tests can be helpful in determining an area of the liver where damage may be taking place and depending on the pattern of elevation can help organize a differential diagnosis. Elevations in ALT and AST in disproportion to elevations in alkaline phosphatase and bilirubin denotes a hepatocellular disease according to **Lala *et al.*,(2022).** This observed in the elevations were agreed with **Umukoro *et al.*,(2015)** who reported that the activity of AST and ALT were elevated in the blood of MSG-treated mice suggesting liver injury. These findings suggested that MSG induced oxidative stress in the brain and impaired liver functions but did not produce any behavioral abnormalities in mice at lower doses. Our result in line with **Tawfik *et al.*,(2012)** who reported that there was significant increases in the serum alanine aminotransferase was observed in the MSG-treated rats compared to the control group . Also **Abbas *et al.*,(2016)** revealed the effect of MSG at two oral low doses of 0.6 and 1.6 mg/g body weight on liver functions during the feeding period (2 weeks) in albino rats and investigated the effect of oral administration of N-acetylcysteine on hepatotoxicity induced by (MSG) in rats. The results showed that elevation of ALP occurred only in the group that was treated with a high dose of MSG and can be attributed to ongoing hepatocellular toxicity that occurs in a higher dose of MSG. Elevation of serum ALP can be an indicator of cholestasis or hepatocellular damage according

to **Abbas *et al.,(*2016)** . Also, our results agree with **Abd El Ghany and El-Metwally (2010)** who determined some chemical composition of marjoram and investigates the treatment effect of marjoram leaves, hydro-alcoholic extract and essential oils on the injured liver in experimental rats. The results demonstrated that *O.majorana* has no harmful effect on hepato-renal functions .The treated group with marjoram leaves showed a significant decrease in gain percent and serum ALT &AST. Also, **Raafat *et al.*, (2018)** who investigated the ameliorative effect of available herbs as celery and sweet marjoram on some biochemical parameters and antioxidant markers in normal and diabetic rats. The obtained results showed that feeding rats a ration mixed on celery 1% and sweet marjoram 1% produced a significant decrease in AST, ALT and Alp levels at $P<0.05$. This effect may be attributed to their phenolic content which are Known to be involved in the healing process of free radical mediated diseases. Moreover their flavonoids which are the active principles, it also possess an inhibitory effect on the aldose reductase enzyme. This enzyme played a role in catalyzing the reduction of glucose to sorbitol which cannot diffuse out of the cell membrane. Also **El Shahat *et al.*, (2016)** indicated that a significant elevation in the activities of AST, ALT, GGT and ALP in the serum of Methotrexate(MTX)-group when compared with control group and this elevation significantly decreased in the group of Methotrexate(MTX)-rats fed on either raw or gamma-irradiated basil.

In the present study, total protein (TP), albumin (Alb) and globulin (Glb) values showed a significant decrease in the positive control group as compared to the negative control group. The best result was found in the treated group with (marjoram 10%) and closed to the normal group. Also the best result with albumin and globulin was found in treated groups with Marjoram (10%) and Basil (10%). This study agreed with **Ashry *et al.*,(2012)** who

reported that monosodium glutamate (MSG) play a critical role in the development of several hepatic disorders. The results of the previous study indicated that rats treated with MSG, showed a significant depletion in the serum total protein level. In relation to the control rats a decrease in serum albumin was reported as animals were treated with MSG .Also **Ezeokeke *et al.*, (2017)** demonstrated that serum total protein , albumin and globulin were significantly ($P<0.05$) decreased in rats treated with MSG when compared with the control group.

In addition, **Abd El-Ghany and El-Metwally (2010)** investigated the treated group with marjoram leaves showed a significant increase in serum globulin compared to the normal control group. Also **Abdel-Wahab (2019)** reported that marjoram powder is a rich source of medicinal components and many biologically active substances, including phenolic acids and flavonoids, which have various physiological and biochemical functions in the body. Levels of dietary marjoram significantly affected the serum concentrations of total protein and albumin in broiler chicks. Specifically, supplementation of marjoram led to increases in total protein and albumin, while, the levels of globulin and A/G ratio were not affected. Moreover, our results are in line with **EL-Hashash (2019)** who concluded that the mean values of total protein and albumin in serum of untreated liver –injured group were significantly lower than those of normal control group. Although only the group fed on basal diet supplemented with the high concentration of SBLP(sweet basil leaves powder) recorded significant increase in serum total protein compared with untreated liver –injured group, both concentrations led to significant increases in serum albumin compared with untreated liver –injured group, with no significant differences between them. Also **Kahilo *et al.*, (2015)** reported that the obtained data revealed that there is significantly increased in group treated with

basil for total protein and showed non-significant changes in albumin. The values of globulin and A\G ratio significantly increased noticed in group treated with basil if compared with non-treated group. The present study showed that, a significant increase in total cholesterol and triglyceride in the positive control group as compared to the negative control group. Our results in line with **Helal *et al.,*(2019)** who studied adverse effects of mono sodium glutamate, sodium benzoate and chlorophyllins on some physiological parameters in male albino rats. The results showed that rats orally administrated with food additives containing MSG showed significant increase in total cholesterol, triglycerides. Increasing effect in cholesterol concentration in the previous study might be an indication of membrane structure and function disruption, thus influence its fluidity, permeability, activity of associated enzymes and transport system. Also, MSG was seen to increase hepatic lipid catabolism via up regulation of oxidative genes .In addition to **Abdulla *et al.*,(2018)** who showed that , marjoram plant improves the liver functions and reduces the serum cholesterol, triglycerides as compared to the positive control group. Also **El-Kholie *et al*.,(2020)** concluded that the lowest cholesterol and triglyceride recorded for the group fed on (5%) mixtures of thyme and basil leaves with significant differences. The obtained results indicated that the cholesterol levels of the positive control group recorded the highest value when compared with a negative control group with a significant difference ($P \leq 0.05$) .Results obtained in the present study showed that, a significant decrease in (HDL) in the positive control group as compared to the negative control group, while this parameter (HDL) recorded a significant increase in the treated groups with marjoram (10%), and basal (10%) as compared to the positive control group. On the other hand, (LDL,VLDL) parameters recorded a significant increase in the positive control group as compared to the negative control group While, these parameters

decreased in all treated groups especially the treated group with (marjoram 10%) which recorded the best result and closed to the normal group. Our results are in line with **Helal *et al.*, (2019)** who revealed that rats orally administrated with food additives containing MSG showed significant increase in LDL-C and VLDL-C levels. While there was a highly significant decrease in HDL level as compared to control rats. These results were consistent with **Hassanen (2012)** who reported that special the studies of the oxidation stress (injected with CcI4) significantly increased in low density lipoprotein (LDL-C), very low density lipoprotein cholesterol (VLDL-C).While HDL- cholesterol was significantly decreased (30.76 %), Administration of the tested antioxidants (marjoram) leaves improved or returned these values to the normal ones. Also **Abdulla *et al.*,(2018)** who demonstrated that Group received a basal diet containing *Origanum majorana* 0.5% in feed all over the experimental period, showed significant decreases in LDL as comparison with control group, while HDL was significantly increased when compared with the control group. Also **Mahmoud *et al.*, (2016)** reported that the mean values of basil resulted in a significant reduction in cholesterol values. Rats that received high salt diets and were treated with basil had lower mean values of LDL-c, VLDL-c and higher mean values of HDL-c compared with the control positive group.

In this study, serum glucose showed a significant increase in the positive control group as compared to the negative control group (114.17 ± 9.85 and 90.83 ± 14.18 mg/dl respectively). All treated group indicated a significant decrease as compared to the positive control group. This study in accordance with **Helal *et al.*,(2019)** administrated adverse effects of mono sodium glutamate, sodium benzoate and chlorophyllins on some physiological parameters in male albino rats. The results showed that mono sodium glutamate group showed highly significant increases in glucose ($P < 0.01$) in

comparison with the control group. Also, these results agree with those found by **Hassanen (2012)** who reported that rats fed on ration (powder) marjoram with injected $Cc1_4$ showed significant decrease in glucose concentration than other groups. Also, **Raafat *et al.*, (2018**) studied ameliorative effect of celery(*Apium gravealens*) and sweet marjoram (*Origanium marjoram*) on some biochemical parameters of diabetic male rats . The results showed that concerning glucose level it was reduced significantly in celery, and sweet marjoram treated rats as compared to diabetic group rats at $P < 0.05$.Moreover, **Widjaja *et al.,*(2019)** who assessed glucose lowering effect of basil leaves in diabetic rats. The results showed that basil leaves extract showed statistical significant lowering blood glucose in the treated rats with basil leaves. This means that basil leaves can be used for lowering blood glucose, It may be due to the ability of basil leaves as anti-diabetic agents and improve the insulin sensitivity.

The present study showed that the mean value of SOD and GPx value showed a significant decrease in the positive control group as compared to the negative control group. All treated groups indicated a significant increase as compared to the positive control group. While, value of MDA showed a significant increase in the positive control group as compared to the negative control group. All the treated groups indicated a significant decrease ($P<0.05$) as compared to the positive control group. This study agreed with **Shukry *et al.,*(2020)** reported a significant decrease in hepatic SOD levels in the MSG group compared to the control group. While showed a significant increase in MDA concentrations in the MSG group compared to our data's control group. Also, **Mondal *et al.,*(2018))** indicated that the MSG induced oxidative stress in ovary tissues, the activities of the antioxidant enzymes and the level of MDA, the biomarker of lipid peroxidation, in the homogenate of the ovary tissues in MSG-exposed rats have been

studied. It was found a significant increase in the activities of SOD, in MSG-exposed ovary tissue homogenate dose and duration dependently compared to the control groups. It was observed significant decrease in the activities of GPx in MSG-exposed ovary tissue homogenate. Our result in line with **Hassanen (2012)** administrated that, level of serum MDA in rats injected with $Cc1_4$ supplemented with marjoram leaves showed a significant reduction which indicates a decreased rate of lipid peroxidation. Supplementation of the experimental rat groups injected with CcI_4 with marjoram powder increased the activities of enzymatic antioxidant, (SOD). Also, **Rababa'h *et al.*,(2021)** observed the changes in the cardiac oxidative stress biomarkers upon Isoproterenol (ISO) treatment, indicated by a decrease in the antioxidant enzyme activities Superoxide dismutase and Glutathione peroxidase (SOD and GPx). Specifically, the SOD and GPx activities increased significantly in the treated group with 50 mg/kg marjoram as compared to the ISO-treated group. Hence, ISO treatment causes a significant reduction in the levels SOD and GPx compared to marjoram administration only. These results agreement with **Fahmy *et al.*,(2016)** administrated that saffron, basil and red cabbage had a protective effect against hepatic damage. Antioxidant enzymes (GP_X and SOD) content were significantly improved in all treated groups than the positive control group. Moreover, serum MDA level significantly decreased in all treated intoxicated groups when compared with the positive control one. Results showed that serum GPX was decreased significantly in rats suffering from hepatic damage (positive control group) compared with the negative control normal group. Also, results showed that serum MDA was increased significantly in rats suffering from hepatic damage (positive control group) compared with the negative control group. Results revealed that all treated groups had decreased

serum MDA significantly when compared with the positive control group.

Finally, the hostopathological examination confirmed the biochemical analysis, which the marjoram and basil leaves improving the liver tissue. These results are agreement with **Gad EL-Hak *et al.*,(2021)** who assess the changes in the liver of pregnant female rats and their fetuses following monosodium glutamate administration Severe histopathological alterations were observed in both maternal and fetal liver tissues of MSG-treated groups. Moreover, histochemical observations showed a reduction of total polysaccharides in the liver of pregnant rats and fetuses. A significant increase in the percentage area of positive immunoreaction for caspase 3 was observed in the liver of treated rats with MSG compared to the liver of the control. The liver of fetuses treated with MSG revealed an alteration like their mother. This study showed that during the gestational period MSG exposure resulted in several biochemical, histological, and histochemical changes in the maternal and fetal liver tissues which emphasize the toxic effect of MSG. Also **Abd El-Ghany and El-Metwally (2010)** reported that liver of rat from the group treated with marjoram leaves showed no histopathological changes. The results suggest that marjoram leaves showed a significant hepatoprotective and hypolipidemic effect against carbon tetrachloride and ethanol induced-liver injury in rats. Also , **Moubarz *et al.*,(2018)** who revealed that the liver of control rats and *Origanum majorana* showed no detectable differences in the histological structure of their liver, so all of them were pooled together. The liver showed a normal structure where the hepatocytes are arranged in branching, interconnecting cords of hepatocytes. The hepatic cords were radiating from the central vein and interposed with hepatic sinusoids. The *Origanum majorana* had antihepatotoxic activity, rats treated with an extract

of marjoram showed almost complete normalization of liver tissues, no fatty degeneration, and no necrosis .The observed improvements may be due to the presence of many antioxidant components found in marjoram. Moreover, **Yacout *et al.*,(2012)** conducted that the liver of rats treated with CCl_4 for 4 weeks showed fibrosis with the loss of structural integrity and formation of nodules that lacked a central vein. When basil was given simultaneously with CCl_4 a distinct decrease in the morphological alteration was observed. Cell size decreased and revealed gradual restoration of the normal structure of liver tissues. The sinusoids were narrow, necrosis and fatty changes were slight, as was connective-tissue proliferation, and inflammatory changes were virtually non-existent.

Conclusion

From the obvious results, it could be concluded that the marjoram and basil powder contained high amounts of antioxidants which could protect livers from oxidative stress induced by monosodium glutamate.

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