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MITIGATION OF TOXIC EFFECTS CAUSED BY TARTRAZINE IN WISTAR RATS THROUGH ORAL ADMINISTRATION OF MELON SEED OIL

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Monitoring and investigation of different toxic effects of frequently used food additives is of vital importance for public health. Tartrazine is an artificial food coloring compound and is extensively used in numerous food items to enhance their aesthetic value. The mechanism of toxic effects of tartrazine is not clear and is under debate. Hence, present work was planned to evaluate the toxicity of tartrazine and to assess the potential of melon seed oil to alleviate the toxic effects of tartrazine in experimental rats. Therefore, different doses of tartrazine alone and along with melon seed oil were given to experimental rats for a period of 60 days. The rats were killed at 20, 40 and 60 days of experiment and blood was collected and analyzed for various hematological and serological parameters. No mortality and behavioral changes were recorded though out the experiment. The results exhibited significant decrease in hematological parameters (hemoglobin and hematocrit), serum lipid profile (cholesterol, triglycerides, low density lipoprotein and high-density lipoprotein) and serum proteins (albumin, total proteins). Results revealed significantly higher levels of liver function tests (aspartate aminotransferase, alanine aminotransferase, bilirubin), renal function tests (urea, creatinine), cardiac enzymes (LDH, CPK and CK-Mb) and malondialdehyde (MDA) in response to various treatments of tartrazine. Different doses of melon seed oil used in current experimental research partially reversed the toxic effects of tartrazine in experimental rats.
Keywords: Food dye, public health, serum biochemistry, cardiac enzymes, oxidative stress.

INTRODUCTION

Food additives enhance various attributes of food like flavor, color and taste (Himri *et al*., 2011). Food dyes are frequently employed in food industries across the globe to make the foods attractive for consumers (Kaur *et al*., 2010). Food coloring compounds can be artificial or natural. Due to low price, greater choice and better processing characteristics of colors, synthetic food coloring compounds are replacing the natural ones in many food items such as beverages, sweets and candies (Schuster and Gratzfeld-Hüsgen. 1995; Alves *et al*., 2008). Tartrazine, an azo food coloring compound (trisodium1- (4-sulfonatophenyl)- 4-(4-sulfonatophenylazo) -5-pyrazolone-3-carboxylate) is frequently and extensively used in different industries and many foods and food by products such as juices, soft drinks, sauces, ice creams, biscuits, coatings and cheeses. For human consumption, acceptable daily intake (ADI) of this dye is 0-7.5 mg/ kg.bw/day (Walton *et al*., 1999; Mehedi *et al*., 2013; Li *et al*., 2014). The mechanisms of its toxicity are not clear and are still under debate concerning its possible toxic effects on public health. It is reported that its consumption at higher doses can result in antagonistic health effects in the presence of different other chemicals (Ward, 1997; Amin *et al*., 2010). Different adverse effects of tartrazine including allergic reactions and others such as urticaria and asthma in consumers have been reported (Moutinho*et al*., 2007). Tartrazine induces carcinogenic effects and has genotoxic potential to lymphocytes and can bind to DNA (Walton *et al*., 1999; Mpountoukas *et al*., 2010). Reports are available about its aphylactic potential, chromosomal aberrations and carcinogenic role in consumers (Collins *et al*.,1990; Giri *et*

al., 1990; Wüthrich, 1993; Reyes *et al*., 1996; Sasaki *et al*., 2002). Such injurious effects of tartrazine urge the researchers to develop some strategies to minimize its detrimental effects. Melon (*Cucumis melo*L.) seed oil is recognized to contain numerous therapeutic properties and health promoting effects. It is an excellent source of super oxide dismutase, oleic and linolenic acids (Lester *et al*., 2009; Vouldoukis *et al*., 2004a; Ismail *et al*., 2010). It is known to possess anti-steatotic and anti-atherosclerotic potential (Decorde*et al*., 2010). As tartrazine is utilized in the preparation of numerous food items and a lot of studies plead for its noxious outcomes; therefore, the current work was planned to examine its hazardous effects on various biochemical parameters of experimental animals and to study the curative effect of melon seed oil.

MATERIALS AND METHODS

***Chemicals*:** All the chemicals needed for analysis of different parameters, tartrazine (food coloring compound) and melon fruit (*Cucumis melo*) golden variety were acquired from market.

***Extraction of melon seed oil*:** The pulpy parts of melon (*Cucumis melo*) fruit were separated and seeds were collected and cleaned with water. The seeds were dried in sun then in hot air oven at 60ºC for 15 hours. Then, the seeds were allowed to cool to ambient temperature and stored in plastic bags. Melon kernels were then ground, and oil extraction was carried out by mean of Soxhlet extraction assembly using ethyl alcohol as solvent. The oil was recovered after the evaporation of solvent (Banat *et al*., 2013).

***Experimental animals*:** Healthy, mature, male albino rats of 7-8 weeks were purchased from Institute of Pharmacy, Physiology and Pharmacology, University of Agriculture Faisalabad. The rats were given basal diet for one week for acclimatization. After acclimatization, the rats were distributed into nine groups (A-I) with twelve animals in each group. Groups (B-I) were given different doses of tartrazine alone and tartrazine along with MSO (Table 1) orally for a period of sixty days. Group A served as control. During the period of trial, the study animals were kept in wire cages. Throughout the trial, the animals had 12 h light-dark cycle and unrestricted availability of feed and water.

Table 1. Experimental grouping and treatments to Wistar rats.

Groups	Treatments
Group A	Control
Group B	2mg tartrazine /kg bw/day
Group C	4mg tartrazine /kg bw/day
Group D	6mg tartrazine /kg bw/day
Group E	8mg tartrazine /kg bw/day
Group F	2mg tartrazine + 0.125ml MSO/kg bw/day
Group G	4mg tartrazine + 0.25 ml MSO /kg bw/day
Group H	6mg tartrazine + 0.375 ml MSO /kg bw/day
Group I	8mg tartrazine + 0.5 ml MSO /kg bw/day

***Blood sampling*:** Blood samples were collected at 20, 40 and 60 days of study by slaughtering four rats from every group. The samples were collected in test tubes containing anti-coagulant and without anti-coagulant. The collected samples were analyzed regarding various hematological and serological parameters (Ahmad *et al*., 2013; Hussain *et al*., 2014). Before sacrificing, the rats were examined carefully to observe any clinical or behavioral alterations

***Hematological studies*:** Hematological parameters (hemoglobin and hematocrit) were analyzed by following the procedure given by Zubair *et al*. (2018).

***Serological studies*:** Serum was separated from the samples by using microcentrifuge and kept at -20°C for further analysis. Blood serum parameters such as urea and creatinine (Solcan *et al*., 2018); bilirubin total, AST and ALT (liver function tests); LDH, CPK and CKMB (cardiac enzymes); cholesterol, triglycerides, LDL and HDL (lipid profile); protein total and albumin (serum proteins) were determined by means of spectrophotometer utilizing their respective kits (Ghaffart *et al*., 2018a;Hussain *et al*., 2018). Serum malondialdehyde (MDA), a product of lipid oxidation and an indicator of oxidative stress was determined (Ghaffar *et al*., 2017a).

***Statistical analysis*:** All the data gained concerning various parameters from this study (Complete Randomized Design-CRD) was analyzed statistically by following the techniques given by Steel *et al.* (1997). DMR (Duncan's Multiple Range Test) was adopted for the comparison of mean values.

RESULTS

No mortality, clinical signs and behavioral changes were observed in rats. Results indicated variations in hematological and serological parameters in exposed experimental Wistar rats. The levels of hemoglobin exhibited significant reductions in their concentration in rats of groups D-E, C-E and B-E at 20, 40 and 60 days of experiment as compared with the control group (Table 2) while various doses of MSO ameliorated these toxicological effects in rats of groups (F-I). Hematocrit concentrations showed significantly decreased levels in groups C-E and B-E at 20, 40 and 60 days of study in rats receiving different doses of tartrazine, whereas various concentrations of MSO reduced the toxic effects of tartrazine in rats of these groups.

The data about different serum biochemical parameters like blood urea (Table 3) depicts that its levels increased in rats treated with varying doses of tartrazine and its concentration increased significantly in groups C-E and B-E at 20, 40 and 60 days of trial as compared to unexposed rats. The concentration of creatinine (Table 3) increased significantly in groups C-E at 20, 40 and 60 days of experiment. Cholesterol (Table 4) depicted significant reductions in its concentrations in groups D-E and C-E at 20, 40 and 60 days

Table 2. Effect of different doses of Tartrazine and MSO (Melon Seed Oil) on hemoglobinand hematocrit of Wistar rats during the study period of 60 days.

Trts/ Days	A	B	C	D	E	F	G	H	I
Hemoglobin (g/dL)									
20	13.8±0.3	13.2±0.7	12.7±0.5	12.3±0.4*	12.2±0.5*	13.3±0.6	12.8±0.5	12.4±0.4*	12.2±0.6*
40	13.9±0.4	12.8±0.4	12.3±0.6*	12.0±0.7*	11.7±0.5*	12.9±0.4	12.4±0.6*	12.1±0.6*	11.9±0.5*
60	13.9±0.3	12.5±0.5*	11.9±0.6*	11.4±0.4*	10.9±0.5*	12.6±0.4*	12.1±0.6*	11.6±0.3*	11.1±0.6*
Hematocrit (%)									
20	41.1±1.7	39.4±1.0	38.9±1.6*	37.9±1.8*	37.3±1.6*	40.4±2.2	39.2±1.9*	38.2±2.1*	38.5±1.8*
40	41.3±1.5	39.0±2.2	37.9±1.5*	37.5±1.8*	37.1±1.3*	39.8±1.8	38.6±1.9*	37.9±2.0*	37.4±1.5*
60	41.6±1.2	38.8±1.7*	37.7±2.1*	37.2±2.0*	36.9±1.5*	39.1±1.5*	38.2±1.6*	37.7±1.8*	37.2±1.1*

Table 3. Effect of different doses of Tartrazine and MSO (Melon Seed Oil) on urea and creatinine of Wistar rats during the study period of 60 days.

Trts/ Days	A	B	C	D	E	F	G	H	I
Urea (mg/dL)									
20	28.4±1.3	29.9±0.7	31.3±1.0*	32.9±1.6*	34.6±1.9*	28.9±1.6	30.6±1.5	31.8±1.6*	33.8±1.7*
40	27.8±1.2	30.8±1.0	32.6±1.5*	35.5±1.4*	38.1±1.7*	29.8±1.9	31.5±1.5*	32.9±1.7*	37.4±2.0*
60	28.1±1.4	32.1±1.2*	35.2±1.9*	37.8±1.8*	43.5±1.9*	31.4±1.4	34.1±1.7*	35.9±1.8*	41.9±2.3*
Creatinine (mg/dL)									
20	0.60±0.02	0.63±0.04	0.65±0.02*	0.66±0.03*	0.70±0.04*	0.62±0.04	0.64±0.02	0.64±0.03	0.68±0.02*
40	0.61±0.01	0.63±0.02	0.67±0.02*	0.68±0.01*	0.72±0.04*	0.62±0.02	0.66±0.03*	0.67±0.01*	0.70±0.04*
60	0.60±0.02	0.64±0.02	0.68±0.03*	0.70±0.01*	0.77±0.02*	0.62±0.02	0.66±0.03*	0.69±0.02*	0.74±0.03*

Table 4. Effect of different doses of Tartrazine and MSO (Melon Seed Oil) on blood lipid profile of Wistar rats during the study period of 60 days.

Trts/ Days	A	B	C	D	E	F	G	H	I
Cholesterol (mg/dL)									
20	93.9±4.9	92.6±4.5	90.0±4.7	85.6±2.6*	82.8±4.5*	93.6±4.2*	91.0±5.0	86.8±2.7*	84.3±3.3*
40	94.4±4.6	91.1±3.7	88.2±4.7	82.0±4.2*	78.7±4.1*	92.2±2.7	89.7±4.6	83.2±4.5*	80.5±2.4*
60	93.7±5.2	87.7±3.8	84.1±4.3*	78.8±4.0*	75.7±3.6*	90.2±3.0	87.3±3.6	83.8±1.8*	76.3±3.8*
Triglyceride (mg/dL)									
20	85.8±4.9	83.6±4.5	80.5±4.5*	77.9±2.7*	75.8±3.9*	85.2±4.6	82.7±4.6	79.1±2.8*	77.8±4.3*
40	86.5±4.4	81.1±3.7*	78.6±3.5*	74.4±3.5*	71.9±3.7*	82.9±4.4	79.8±4.1*	76.9±3.6*	73.2±3.9*
60	86.9±4.1	79.5±4.1*	75.1±2.4*	70.1±3.3*	69.7±3.3*	81.9±4.4	78.0±3.5*	73.3±3.2*	72.9±1.8*
LDL (mg/dL)									
20	34.4±1.8	33.4±1.3	31.8±1.3	28.5±1.0*	26.3±1.3*	33.9±1.2	32.9±1.2	30.2±1.5*	27.3±1.4*
40	35.2±2.3	32.2±2.5	30.5±2.4*	27.9±1.9*	25.8±2.3*	33.2±2.8	31.5±2.5	29.2±1.9*	26.8±1.7*
60	34.5±1.5	31.2±1.5	27.9±1.3*	26.9±1.4*	24.9±1.3*	32.8±1.8	31.5±1.8	28.3±1.3*	26.2±0.3*
HDL (mg/dL)									
20	40.1±2.1	37.8±1.4	36.9±1.7	33.7±1.7*	32.8±1.9*	39.2±2.1	38.2±1.9	34.5±1.2*	33.9±1.5*
40	41.1±1.7	37.2±1.9*	35.8±1.4*	33.4±1.6*	32.1±1.3*	36.4±1.8*	33.8±1.4*	32.0±1.5*	31.4±1.7*
60	41.5±1.8	35.6±1.6*	34.9±1.6*	31.8±1.7*	31.4±1.1*	39.2±1.9	37.9±0.6	35.4±1.9*	34.1±1.6*

of study in treated rats. Levels of triglycerides (Table 4) revealed significant decrease in rats of groups C-E and B-E at 20, 40 and 60 days of study. Results of this experimental study exhibited significantly lower levels of low density lipoprotein (LDL) in groups D-E and C-E at 20, 40 and 60 days of experiment. The levels of high density lipoprotein (HDL) exhibited significantly decreased levels in rats (Table 4) of groups D-E and B-E at 20, 40 and 60 days of the experiment. In rats of groups (F-I) various doses of MSO partially lessened the effect of tartrazine on the concentrations of cholesterol, triglycerides, LDL and HDL throughout the study period.

Table 5. Effect of different doses of Tartrazine and MSO (Melon Seed Oil) on Bilirubin, AST and ALTof Wistar rats during the study period of 60 days

Trts /Days	A	B	C	D	E	F	G	H	I
Bilirubin (mg/dL)									
20	0.45±0.01	0.46±0.01	0.47±0.02	0.50±0.02*	0.53±0.02*	0.45±00.02	0.46±0.02	0.49±0.01*	0.51±0.02*
40	0.44±0.02	0.47±0.02	0.48±0.01	0.51±0.04*	0.54±0.02*	0.46±0.02	0.47±0.01	0.50±0.01*	0.52±0.03*
60	0.45±0.01	0.48±0.03	0.50±0.02	0.53±0.02*	0.58±0.03*	0.47±0.02	0.49±0.02	0.51±0.01*	0.55±0.03*
AST (U/L)									
20	39.5±2.0	40.5±1.2	43.4±2.0*	45.9±2.5*	46.3±2.3*	39.7±1.2	41.9±2.4	44.7±2.1*	45.1±1.6*
40	39.8±1.9	41.5±1.6	44.9±2.3*	47.8±2.2*	51.9±2.7*	40.9±1.0	43.8±2.3	46.2±2.0*	49.6±2.7*
60	40.1±1.9	43.3±1.2	47.3±2.2*	51.6±2.7*	56.7±3.0*	41.5±1.7	45.4±2.3	49.9±2.1*	52.8±2.1*
ALT (U/L)									
20	49.8±2.3	50.9±1.8	51.1±1.6	54.7±0.9*	56.5±2.1*	50.1±2.4	50.4±1.2	53.1±1.8	54.9±1.9*
40	50.1±2.3	53.3±2.6	54.8±2.1*	56.5±2.5*	59.8±2.7*	52.5±2.5	53.4±1.9	54.9±2.4	57.9±2.2*
60	49.8±2.7	54.3±2.4	56.2±2.8*	61.5±1.9*	67.7±3.3*	53.1±2.1	55.1±2.6	59.7±2.1*	65.7±2.7*

Table 6. Effect of different doses of Tartrazine and MSO (Melon Seed Oil) on LDH, CPK and CKMB of Wistar rats during the study period of 60 days.

Trts/ Days	A	B	C	D	E	F	G	H	I
LDH (U/L)									
20	162.5±3.9	164.3±6.7	165.7±7.7	167.9±6.7	168.3±8.1	162.9±5.7	163.1±8.7	165.1±7.9	166.4±7.5
40	160.7±5.4	166.9±7.0	170.4±8.8	175.8±7.2*	180.8±8.4*	164.5±6.6	167.6±9.3	172.9±6.4	177.6±9.3*
60	161.3±4.9	168.1±7.5	173.5±8.3	178.3±6.0*	185.1±6.8*	164.6±5.3	169.1±6.6	174.4±5.8*	179.8±6.6*
CPK (U/L)									
20	32.7±1.6	33.1±1.3	34.4±1.9	39.1±1.6*	45.6±2.2*	32.9±1.3	33.2±1.8	37.9±1.8*	43.7±2.2*
40	33.4±1.5	34.1±1.8	35.8±2.2	40.5±1.4*	47.8±2.1*	33.8±1.3	34.3±1.9	39.7±2.2*	44.5±2.4*
60	33.6±1.2	34.8±1.8	36.8±1.5	44.9±2.5*	51.1±2.8*	34.1±1.6	35.6±1.8	43.9±2.3*	49.3±2.5*
CK-Mb (U/L)									
20	81.0±3.3	83.1±4.3	85.5±3.4*	91.7±4.0*	95.7±5.0*	81.9±4.7	84.5±2.7	90.0±3.7*	94.5±4.3*
40	82.1±3.4	85.2±2.8	88.1±4.1*	95.8±5.2*	99.4±3.9*	84.2±4.1	85.3±4.4	88.4±3.0*	96.8±2.1*
60	81.8±3.7	87.8±4.9	90.7±4.6*	98.5±5.4*	103.4±5.8*	85.5±4.0	87.4±3.8	96.3±3.9*	99.9±3.7*

Table 7. Effect of different doses of Tartrazine and MSO (Melon Seed Oil) on serum total protein, albumin and serum MDA of Wistar rats during the study period of 60 days.

Trts/ Days	A	B	C	D	E	F	G	H	I
Total Protein (g/dL)									
20	6.05±0.34	5.90±0.31	5.78±0.26	5.63±0.31	5.58±0.24	5.95±0.22	5.83±0.31	5.68± 0.30	5.63±0.30
40	6.10±0.32	5.75±0.24	5.63±0.18	5.50±0.21	5.45±0.23	5.80±0.25	5.70±0.26	5.60±0.28	5.53±0.21
60	6.08±0.20	5.55±0.20*	5.40±0.23*	5.18±0.13*	4.98±0.17*	5.63±1.15	5.48±0.17*	5.30±0.15*	5.18±0.11*
Albumin (g/dL)									
20	2.80±0.15	2.73±0.13	2.60±0.11	2.45±0.10*	2.30±0.16*	2.76±0.09	2.65±0.12	2.53±0.13	2.40±0.14*
40	2.75±0.12	2.55±0.15	2.43±0.16	2.20±0.11*	2.09±0.12*	2.63±0.07	2.53±0.13	2.33±0.15*	2.20±0.11*
60	2.93±0.16	2.38±0.10*	2.25±0.17*	2.09±0.08*	2.03±0.09*	2.51±0.12*	2.43±0.13*	2.31±0.14*	2.15±0.08*
MDA (nmol/g)									
20	3.23±0.13	3.28±0.17	3.30±0.19	3.35±0.15	3.49±0.18	3.23±0.17	3.25±0.15	3.28±0.11	3.43±0.13
40	3.25±0.14	3.33±0.17	3.38±0.13	3.46±0.09	3.55±0.16	3.28±0.17	3.33±0.03	3.42±0.14	3.52±0.17
60	3.42±0.09	3.58±0.11	3.68±0.19	3.77±0.17*	4.28±0.20*	3.43±0.20	3.55±0.17	3.63±0.19	4.00±0.20*

* The values (Tables 2-7) having asterisk (mean ±SE) in different groups have significant difference ($P \leq 0.05$) from control group.

The values of different liver function tests (Table 5) showed significant elevation in tartrazine exposed rats. The concentrations of bilirubin in treated rats were significantly higher in groups D-E at 20, 40 and 60 days of trial in comparison to group A (control). The quantity of AST in rats of groups C-E at 20, 40 and 60 days increased significantly

when compared to untreated rats (group A). The quantity of ALT significantly increased in tartrazine treated rats in groups D-E and C-E at 20, 40 and 60 days of experiment.

The quantity of LDH (Table 6) significantly increased in groups D-E at 40 and 60 days of trial. The administration of MSO partially reduced these effects in groups F-I. Results of this experimental research revealed that the concentration of cardiac enzyme CPK significantly increased in rats of groups D-E at 20, 40 and 60 days of the trial. In case of CK-Mb, significant increased quantity was recorded in groups C-E at 20, 40 and 60 days of the study. However, various doses of MSO partially reduced these elevations in treated rats. The quantity of serum total proteins (Table 7) significantly reduced in rats kept in groups B-E at 60 days of trial. Serum albumin (Table 7) reduced significantly in treated rats of groups D-E and B-E at 20, 40 and 60 days of experiment while the administration of MSO along with tartrazine treatments in groups F-I partially reduced the toxic effects of various doses of tartrazine. The concentrations of MDA showed significant elevations in groups D-E at 60 days of research while administration of various doses of MSO decreased this elevation in groups F-I and significant increase could be noted in group I only at 60 days of trial.

DISCUSSION

Different coloring compounds are frequently used in food industry to enhance the aesthetic value of different food products. These substances induce adverse effects on public health (Erdemli*et al.,* 2017). Tartrazine, an azo, syntheticdye is widely used as a food coloring compound. Monitoring and evaluation of such compounds is of vital importance and crucial to lower the deleterious effects on public health. Therefore, the current experimental study investigated different adverse effects of tartrazine at low concentrations in rats. In exposed rats the lower levels of hemoglobin might be due to oxidative stress of tartrazine on blood forming tissues (Wang *et al*., 2009; Li *et al*., 2014; Ghaffar *et al.,* 2018b).

The determination of urea and creatinine is of vital importance to assess the efficiency of kidneys and glomerular filtration (Wadei*et al*., 2006; Ghaffar *et al.,* 2017b). The increased concentrations of kidney biomarkers (urea contents) in tartrazine administered rats in this experimental study has been reported by many researchers (Helal*et al*., 2000; Tawfek*et al*., 2015; Erdemli*et al.,* 2017) who mentioned elevations in the concentrations of urea in experimental animals. Similar findings have also been reported by different researchers due to tartrazine in experimental animals (Amin *et al*., 2010; Mehedi *et al*., 2013). The higher concentrations of creatinine in tartrazine treated rats can be due to toxic effects of tartrazine leading to damage to kidneys and abnormal glomerular filtration caused by renal dysfunction (Timbrell, 2009; El-Wahab and Moram, 2013;Erdemli *et al*., 2017). Previously it is reported that the concentrations of urea and creatinine increases as a result of degenerative changes in kidneys induced by harmful substances (Himri*et al*., 2011; Gul *et al.,* 2017). The higher values of urea and creatinine in exposed rats might also be due to oxidative damage to kidneys as a result of sulphanilc acid production by azo fission of tartrazine (Bhatt *et al*., 2018; Hussain *et al.,* 2018). Furthermore, it is determined that the levels of urea and creatinine partially reduced in rats administered melon seed oil. Previously beneficial and therapeutic potential of MSO on kidneys have also been reported (Vouldoukis*et al*., 2004b; Fahamiya *et al*., 2012). Moreover, it is investigated that melon seed oil play important role in treatment of different problems of urinary tract like bladder stones and ulcer of urinary tract (Ivanova, 2012, Fahamiya *et al*., 2016).

The concentrations of different lipid profile parameters such as total cholesterol, triglycerides, high density and low-density lipoprotein reduced in tartrazine exposed rats. These findings concerning lipid profile are in line with the previous reports of artificial food colorants (Sharma *et al*., 2006; Ashour and Abdelaziz, 2009; Amin *et al*., 2010). Reductions in the concentration of these parameters might be due to hypolipidemia resulting from abnormalities in the biosynthetic function of liver (Rini*et al*., 1981; Cicognani*et al*., 1997).

The increased concentrations of different liver function tests in tartrazine exposed rats are in line with previously published reports (Amin *et al*., 2010; Saxena and Sharma 2015;Khayyat *et al*., 2017). The higher levels of different hepatic parameters in rats could be due to damage to hepatocellular tissues (Mekkawy*et al*., 1998; Mehedi *et al*., 2013; Erdemli *et al.,* 2017; Subhani *et al.,* 2018). However, various doses of MSO caused reduction in these elevations that justify its therapeutic effect. The protective effect of MSO is associated to its higher levels of antioxidants that prevent lipid peroxidation leading to safer liver (Muth*et al*., 2004; Vouldoukis*et al*., 2004a; Vouldoukis*et al*., 2004b; Ivanova, 2012; Mehmood *et al.,* 2018).

The increased cardiac enzymes in this study are in-agreement with the earlier reports (Oyewole and Oladele, 2016) due to tartrazine. The higher levels of these enzymes can be due to toxic constituents given to experimental animals (Adesokan*et al*., 2004; Ghaffar *et al.,* 2017) and leading to injurious stimuli to heart (Perry *et al*., 1997; Clapp, 2009). In present study, the protective role of melon seed oil has also been reported (Nestler *et al*., 1999; Giordano *et al*., 2011; Ivanova, 2012).

Reductions in serum total protein and albumin in exposed rats are in line with the previous reports (Ibrahim *et al*., 2012; Elbanna *et al*., 2017). Lower levels of serum proteins might be due to increased oxidative stress resulting in poor protein biosynthesis in various tissues of the experimental animals.

The higher concentrations of MDA in rats due to tartrazine exposures in present study have also been reported (Amin *et al*., 2010; Gao *et al*., 2011; Ali *et al*., 2016). The higher levels

of MDA might be due to transformation of tartrazine into sulfanilic acid in gastrointestinal tract that produces increased reactive oxygen species (Bansal *et al*., 2005; Moutinho *et al*., 2007; Bhatt *et al.*, 2018; Ghaffar *et al.*, 2018b). It is determined that ROS react with lipids of cellular membranes of different cells (Amin *et al*., 2010), increases lipid peroxidation products and inhibit antioxidants status in animals (Mehedi *et al*., 2013). The results of present study in relation to melon seed oil effects are also in line with the results reported by Somade*et al*. (2014) who described lower concentration of MDA in rats receiving MSO.

***Conclusion*:** The findings of present experimental study indicate that tartrazine induces adverse toxic effects in rats when administered for long duration even at very low concentration. Hence, long term consumption of foods containing this food colorant may lead to toxic effects on public health. On the other hand, MSO has potential to alleviate the toxic effects caused by tartrazine.

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