The therapeutic role of vitamin C against acrylamide-induced hepato-renal toxicity

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ABSTRACT

This study aims to investigate the therapeutic role of vitamin C against acrylamide-induced hepatorenal toxicity in male and female rats. Forty -two male and female albino rats were divided into three groups. Acrylamide was administered daily in drinking water as the above and vitamin C was given daily in drinking water for 4 weeks. Dissolved 5000 mg of effervescent vitamin C tablets produced by the Chemical Industries Development Company (CID) in 500 ml of water and each 1 ml of water contains 2 mg of vitamin C and given 20 ml of the solution for the male cage and 30 ml for the female cageThere was a significant decrease of ALT activity within the control group (50.50±11.03 U/L) where in rats drinking acrylamide there was increase (55.00±8.59 U/L) acrylamide and treated with vitamin C, were the least activity(45.92±9.12 U/L) there are no differences between male and female in ALT activity in the control group, and vitamin C group ($P > 0.05$), but in acrylamide group there was significant difference ($P < 0.05$) between male and female and there was no significant decrease ($P > 0.05$) in level of creatinine in rats drinking acrylamide compared with the control group indicated that, there was decrease the mean level of urea in rats drinking acrylamide and treated with treated with vitamin C with an extremely significant decrease ($P < 0.0001$) compared with rats drinking acrylamide only or compared with control group. there was no significant increase in HDL level in rats drinking acrylamide and treated with vitamin C compared with rats drinking acrylamide only. there was no significant decrease in level of LDL level in rats drinking acrylamide compared with control group. Finally there was decrease the mean level of Superoxide dismutase in rats drinking acrylamide treated with vitamin C compared with rats drinking acrylamide only with no significant difference. Moreover, in rats drinking acrylamide treated with vitamin C there was significant increase ,here was increase the mean level of Glutathione reductase in rats drinking acrylamide treated with vitamin C with no significant difference compared with rats drinking acrylamide only and compared with control group and decrease the mean level of Lipid peroxide in rats drinking acrylamide treated with vitamin C. acrylamide caused many adverse effects in the anzyme and Liver Kidney functions reflected in significant increase that caused damage to them. The administration of vitamin C in combination to reduce the damage caused with acrylamide significantly.

Keywords: Acrylamide, Liver functions, Kidney functions , rats, vitamin C.

INTRODUCTION

Acrylamide (ACR) Acrylamide is a white crystalline odorless compound soluble in alcohol and water, but insoluble in heptane and benzene. It is formed of “acrylic-amide with its formula C3H5NO, is a water soluble vinyl monomer used extensively in the production of polyacrylamide during high-temperature cooking and processing of plant-derived raw materials was[1]. It is obvious that any chemical insult could

cause injury to cells in animal if it is consumed beyond the safe doses. Susceptibility to chemicals, exhibits variation among the tissues and cells. The extent of severity of tissue damage is a function of the concentration and potentiality of the toxic compound in certain types of food processed at high temperature[2]. (ACR) is an α, β-unsaturated carbonyl compound fig 1A with a significantly high chemical activity. The International Agency for Research on Cancer (IARC)and the World Health Organization and theInternational Agency for Research on Cancer as probably carcinogenic to humans, based on its carcinogenic action in rodents used in the treatment of water, cosmetics and paper packaging. Acrylamide is largely oxidized in mice, rats and humans to glycidamide (GA) fby its oxidating agent Cyp p450 2EI where undergoes biotransformation by conjuga-tion with glutathione [3.4] Acrylamide has many health hazards and the mechanisms involved in Acrylamide (ACR) neuro-toxicity are scarcely understood; however, recent studies have shown that these mechanisms are associated with the enhancement of lipid peroxidation (LPO) and the reduction of the antioxidative capacity in nerve tissue mostly caused by a primary depletion of reduced glutathione (GSH) [5]. proven to be carcinogenic in animals and a probable human carcinogen mainly formed in foods by the reaction of asparagine (free amino acid) with reducing sugars (glucose and fructose) as part of the Maillard reaction during heating under high temperature and low moisture conditions[6].Vitamin C (Vit.C) Ascorbic acid plays a role as a redox cofactor and catalyst in a broad array of biochemical reactions and processes. is stable in many organic and inorganic acids. m-Phosphoric acid–containing ethylenediamine tetraacetic acid (0.5%–2%), oxalic acid, dilute trichloroacetic acid, dilute perchloric acid, or 2,3-dimercaptopropanol are often used as solvents or solutions for tissue extraction[7] Vit.C. is the cell's universal reducing agent. It performs redox reactions by free-radical mechanisms to activate the mono- and dioxygenases vital for many aspects of normal cellular metabolism. is required for the growth and repair of all tissues owing in part toi ts role as a cofactor for prolyl and lysyl hydroxylase activity, which is essential for collagen formation and wounds healing. at also works reverse lipid peroxidationWhen the peroxyl radicals are generated in plasma, vitamin C is consumed faster than other antioxidants, for example, uric acid, bilirubins, and vitamin E . Ascorbic acid is 103 more reactive than a polyunsaturated fatty acid in reacting with peroxyl radicals. In contrast, ascorbic acid is not as effective in scavenging hydroxyl or alkoxyl radicals[8]. In a variety of other functions, the role of ascorbic acid in cellular metabolism can be accounted for by its reducing properties to protect cellular components from oxidative damage. It acts as a scavenger for oxidizing free radicals and harmful oxygen-derived species, such as the hydroxyl radical, hydrogen peroxide, and singlet oxygen Certain biochemical reactions are known to be stimulated by the prooxidant activity of ascorbic acid. The bactericidal and antivira activity of ascorbic acid in aqueous solution is presumably attributable to its prooxidant properties[9]. The present study was therefore have designed to investigate the therapeutic role of vitamin C against acrylamide-induced hepatorenal toxicety on male and female rats, such as physiological study Liver functions(Alanine Transaminase (ALT) Enzyme ,Aspartate transaminase (AST) enzyme,Albumin)Kidney functions (Creatinine,Urea). Lipid profile study(Cholesterol,Triglycerides,HDL ,LDL) and Antioxidants profile(Superoxide dismutase,Glutathione reductase,. Lipid peroxide (MDA).

MATERIALS AND METHODS

Obtained Wester albino rat (male and female rat weighing about 80-120 g) from Animal House College of Science University Sebha. Animals were maintained on a standard diet and housed, in polystyrene cages in a room free from any source of chemical contamination, artificially lit (12 h dark / light cycle) and thermally controlled (25 ± 2° C). All animals received human care according to the guidelines of the Ethics Committee. Experiments began after the animals were allowed to adapt for four weeks.

Rats were divided randomly into 3 groups as follows:

G1: (Control group): include 7 males and 7 females in separate cages were fed in normal diet. G2: (Acrylamide group): include 7 males and 7 females separately and were administered daily acrylamide in drinking water (50mg /kg body weight) for 4 weeks. G3: (Acrylamide and vitamin C group): include 7males and 7 females separately. Acrylamide was administered daily in drinking water as the above and vitamin C was given daily in drinking water for 4 weeks. Dissolved 5000 mg of effervescent vitamin C tablets produced by the Chemical Industries Development Company (CID) in 500 ml of water and each 1 ml of water contains 2 mg of vitamin C and given 20 ml of the solution for the male cage and 30 ml for the female cage. After 4 weeks, from the beginning of the experiment, rats of all groups were sacrificed and blood sample were collected as follow: Rats were anesthetized with chloroform. Blood samples were collected directly form heart by 5ml syringe. Blood was collected in heparinized tubes from heart directly under deep an aesthesia with chloroform, Plasma was obtained from centrifugation of the 2nd part tubes for 10 min, 3000 r.p.m. Plasma was stored in -20˚ C until used. At the end of the experimental period, rats were fasted overnight, anesthetized under diethyl ether, and then the rats from each group were sacrificed. The blood was collected and kept in tubes with and without anticoagulant for serum and plasma separation and for whole blood respectively. Serum and plasma samples were kept at -70 °C till analysis.

RESULTS

External feature of acrylamide exposed rates morphologic changes were observed from the 4th week of acrylamide treatment. These changes are in lose weight and neuropathies, hands and feet numbness, gait abnormalities, muscle weakness, ataxia, skin damage and in some case. it was reliance on the acrylamide group only, The results are expressed as Mean ±SE. Analysis of data was performed by one-way analysis of variance (ANOVA) followed by

Post hock Duncan test using the SPSS v 25 (statistical package for social sciences) software for windows. P value less than 0.05 was considered statistically significant.

1. Liver functions

1.1. Alanine Transaminase (ALT) Enzyme

Table 1 show, the mean activity of ALT in the control group was (50.50±11.03 U/L) and in rats drinking acrylamide only the activity was (55.00±8.59 U/L), moreover the activities were (45.92±9.12 U/L) in rats drinking acrylamide and treated with vitamin C.Statistical analysis, ANOVA test indicated that, there was no significant difference among the groups of the present study, ($p > 0.05$). Student T-test indicated that, there was no significant decrease ($P > 0.05$) in activity of ALT in rats drinking acrylamide compared with control group **(table 1).**

In addition, statistical analysis (t-test) it indicates that, there was decrease the mean activity of (ALT) in rats drinking acrylamide and treated with vitamin C compared

with rats drinking acrylamide only (P < 0.05) but there was no significant difference (P > 0.05) compared with control group **(table 1).**

Statistical analysis for the differences between male and female shows that, there are no significant differences (P > 0.05) in ALT activity between male and female in the control group and Acrylamide and vitamin C group except acrylamide group there was significant differences (P < 0.05) between male and female; **(table 2).**

1.2. Aspartate transaminase (AST) enzyme

Table 1 shows, the mean activity of AST in the control group was (198.08±36.91 U/L) and in rats drinking acrylamide alone, the activity was (207.50±71.42 U/L) moreover the activities of AST were (159.58±48.74 U/L) in rats drinking acrylamide treated vitamin C. Statistical analysis (one-way ANOVA) indicated that, there was no significant difference in AST (p > 0.05) among all groups. By student T-test, there was no significant decrease (P > 0.05) in activity of (AST) in rats drinking acrylamide compared with control group **(table 1).**

T-test indicated that, there was decrease the mean activity of AST in rats drinking acrylamide treated with vitamin C compared with rats drinking acrylamide only with significant difference (P < 0.05) and compared with controls **(table 1).**

Moreover, statistical analysis for the differences between male and female shown that, there was high significant difference (P < 0.01) in AST activity between male and female in the control group, and in Acrylamide and vitamin C group but there was no significant difference in acrylamide group **(table 2).**

1.3. Albumin

As shown in table 1, the mean level of albumin in the control group was 3.60±0.41g/dl) and in rats drinking acrylamide alone the level was (3.57±0.27 g/dl) moreover the levels were (3.33±0.50g/dl) in rats drinking acrylamide treated vitamin C. Statistical analysis (one-way ANOVA) indicated that, there was no significant in the albumin (p > 0.05) among all groups.

In addition, statistical analysis for the differences between male and female showed that, there was very high significant difference (P < 0.001) in acrylamide group. There was an extremely significant difference (P < 0.0001) in control group, and high significant difference (P < 0.01) in group of Acrylamide and vitamin C; **(table 3).**

Table 1: liver functions in rats drinking Acrylamide and treated with Vitamin C

Groups		**ALT** (U/L)	**AST** (U/L)	**Albumin** (g/dl)
Control (G1)	Mean ± SD	50.50±11.03	198.08±36.91	3.60±0.41
Acrylamide (G2)	Mean	55.00±8.59	207.50±71.42	3.57±0.27
Acrylamide and vitamin C group (G3)	Mean	45.92±9.12	159.58±48.74	3.33±0.50

P: probability (one-way ANOVA); **P1**: compared with control group; P**2**: compared with acrylamide group; P > 0.05 considered not significant, * P < 0.05 considered significant, **P < 0.01 considered high significant, and ***P < 0.0001 considered extremely significant.

Statistical analysis (one-way ANOVA) indicated that, there was no significant in the AST (p > 0.05) among all groups.

Table (2): Statistical analysis of the activity of alanine aminotransferase (ALT) in males and females of the different groups under study

Group	ALT (U/L)			AST (U/L)		
	Mean ± SD		P val-ue	Mean ± SD		P value
	Male	Female		Male	Female	
Control (n=12)	54.7±12.7	46.3±8.0	> 0.05	222.7±32.5	173.5±22.1	< 0.01**
Acrylamide (n=14)	49.3±8.7	58.1±7.4	< 0.05*	194.0±39.0	220.9±95.5	> 0.05
Acrylamide & Vitamin C (n=14)	49.2±8.8	42.7±8.9	> 0.05	190.5±48.5	128.7±24.2	< 0.01**

P: compared between male and female; P > 0.05 considered not significant, * P < 0.05 considered significant, **P < 0.01 considered high significant, and ***P < 0.0001 considered extremely significant.

Table (3): Statistical analysis of the mean level of Albumin in males and females of the different groups under study

Group	Male	Female	P value
Control (n=12)	4.0±0.3	3.3±0.1	< 0.0001***
Acrylamide (n=14)	3.8±0.2	3.4±0.1	< 0.001**
Acrylamide and vitamin C (n=14)	3.0±0.2	3.7±0.4	< 0.01**

P > 0.05 considered not significant, * P < 0.05 considered significant, **P < 0.01 considered high significant, and ***P < 0.0001 considered extremely significant.

2. Kidney functions

2.1. Creatinine

As shown in table 4, the mean level of creatinine (mg/dL) in the control group was (0.86±0.09 mg/dl) and in rats drinking acrylamide, the level was (0.81±0.13 mg/dl), moreover the levels were (0.82±0.84 mg/dl) in rats drinking acrylamide and treated with vitamin C. Statistical analysis (one-way ANOVA) indicated that, there was no significant difference in creatinine level among groups (p > 0.05).

Also, statistical analysis by t-test for the differences between male and female shows that, there was no significant difference in level of creatinine between male and female in Acrylamide and vitamin C group, on the other hand there were significant differences in control group (P < 0.01), acrylamide group (p < 0.001), respectively; **(Table 5).**

2.2. Urea

As shown in table 4 and, the mean level of Urea (mg/dl) in the control group was (61.50±9.51 mg/dl) and in rats drinking acrylamide alone, the level was (53.00±4.79 mg/dl), moreover the levels were (44.08±5.11mg/dl).67 in rats drinking acrylamide and treated with vitamin C. Statistical analysis (one-way ANOVA) indicated that, there was an extremely high significant difference in the urea ($p < 0.0001$) among all groups.

In addition, statistical analysis t-test for the differences between male and female shows that, there is no significant differences ($P > 0.05$) in Urea between male and female in all groups in female compared with male; **(Table 5).**

Table 4: Kidney functions in rats drinking acrylamide and treated with Vitamin C

Groups		Creatinine (mg/dl)	Urea (mg/dl)
Control (G1)	Mean ± SD	0.86±0.09	61.50±9.51
Acrylamide (G2)	Mean	0.81±0.13	53.00±4.79
Acrylamide and vitamin C group (G3)	Mean	0.82±0.84	44.08±5.11

P: probability (one-way ANOVA); **P1**: compared with control group; P**2**: compared with acrylamide group; $P > 0.05$ considered not significant, * $P < 0.05$ considered significant, **$P < 0.01$ considered high significant, and ***$P < 0.0001$ considered extremely significant.

Table (5): Statistical analysis of the mean of Creatinine and urea in males and females of the different groups under study

Group	Creatinine (mg/dL)			Urea (mg/dL)		
	Mean ± SD		P value	Mean ± SD		P value
	Male	Female		Male	Female	
Control (n=12)	0.90±0.10	0.8±0.10	< 0.01*	65.0±10.7	58.0±7.5	> 0.05
Acrylamide (n=14)	0.90±0.10	0.7±0.10	< 0.001**	56.0±4.2	50.4±3.7	> 0.05
Acrylamide & Vitamin C (n=14)	0.80±0.06	0.83±0.10	> 0.05	42.0±4.6	46.2±5.1	> 0.05

P: compared between male and female; $P > 0.05$ considered not significant, * $P < 0.05$ considered significant, **$P < 0.01$ considered high significant, and ***$P < 0.0001$ considered extremely significant.

3. Lipid profile study

3.1 Cholesterol

The mean level of cholesterol in the control group was (62.25±7.47 mg/dl) and in rats drinking acrylamide, the level was (62.00±9.49 mg/dl) moreover the levels were (59.0±7.53 mg/dl) in rats drinking acrylamide and treated with vitamin C. Statistical analysis (one-way ANOVA) indicated that, there is no significant difference in cholesterol level ($p > 0.05$) among all studied groups.

Moreover, statistical analysis t-test for the differences between male and female shown that, there was no significant difference ($P > 0.05$) in cholesterol between male and female in all groups of the present study except vitamin C group ($P < 0.01$); **(table7).**

3.2 Triglycerides

The mean level of triglycerides of the control group was (71.08±12.20 mg/dl) in rats drinking acrylamide, the level was (69.071±17.66mg/dl), moreover the levels were (96.08±20.46mg/dl) in rats drinking acrylamide treated with vitamin C. Statistical analysis (one-way ANOVA) indicated that, there is an extremely high significant difference in Triglycerides level ($p < 0.0001$) among all studied groups.

However, t-test, for the differences between male and female showed that, there was no significant difference ($P > 0.05$) in triglycerides between male and female in all groups of the present study except rats drinking acrylamide only there was high significant difference ($P < 0.01$); **(Table 7).**

Table 6: Cholesterol and Triglyceride in rats drinking acrylamide and treated with Vitamin C

Groups		**Cholesterol** (mg/dl)	**Triglycerides** (mg/dl)
Control (G1)	Mean ± SD	62.25±7.47	71.08±12.20
Acrylamide (G2)	Mean	62.00±9.49	69.07±17.66
Acrylamide and vitamin C(G3)	Mean	59.0±7.53	96.08±20.46

P: probability (one-way ANOVA); **P1**: compared with control group; P**2**: compared with acrylamide group; $P > 0.05$ considered not significant, * $P < 0.05$ considered significant, **$P < 0.01$ considered high significant, and ***$P < 0.0001$ considered extremely significant.

Table (7): T- test of the mean of Cholesterol and Triglycerides in males and females of the different groups under study

Group	Cholesterol (mg/dL)			Triglycerides (mg/dL)		
	Mean ± SD		P value	Mean ± SD		P value
	Male	Female		Male	Female	
Control (n=12)	65.0±8.4	59.5±5.8	> 0.05	75.8±9.8	66.3±13.3	> 0.05
Acrylamide (n=14)	64.9±9.8	59.1±9.0	> 0.05	56.3±12.9	81.9±11.3	< 0.01*
Acrylamide & Vitamin C (n=14)	54.7±7.5	63.3±4.8	< 0.05*	88.3±11.5	103.8±25.4	> 0.05

P: compared between male and female; P > 0.05 considered not significant, * P < 0.05 considered significant,
**P < 0.01 considered high significant, and ***P < 0.0001 considered extremely significant.

3.3. HDL

As shown in table, the mean level of HDL **(mg/dL) i**n the control group was (40.03±10.36 mg/dl) and in rats drinking acrylamide, the level was (31.73±9.34 mg/dl) moreover the levels were (23.08±13.30mg/dl) in rats drinking acrylamide and treated with vitamin C. Statistical analysis (one-way ANOVA) indicated that, there is high significant difference in HDL level ($p < 0.01$) among all studied groups. Post hock test.

In addition, statistical analysis (t-test) it indicates that, there was no significant increase in HDL level ($P > 0.05$) in rats drinking acrylamide and treated with vitamin C compared with rats drinking acrylamide only. There was significant increase in HDL level ($P < 0.01$) in rats drinking acrylamide and treated with vitamin C compared with control; **(Table 8).**

In addition, statistical analysis (t-test) for the differences between male and female shown that, there was significant difference ($P < 0.05$) in the control group, an extremely significant difference ($P < 0.0001$) in acrylamide group and vitamin C group, in HDL of male compared with female; **(Table8).**

3.4. LDL

As shown in table 15, the mean level of LDL **(mg/dL) i**n the control group was (10.13±5.43 mg/dl) and in rats drinking acrylamide, the level was (14.11±7.87 mg/dl) moreover the levels were (19.2±8.85mg/dl) in rats drinking acrylamide treated with vitamin C. Statistical analysis (one-way ANOVA) indicated that, there was significant difference in LDL level ($p < 0.05$) among all studied groups; **(table 8).** Post hock test.

Also, there was an extremely high significant difference (P < 0.0001) in LDL between male and female in all groups (**table 9).**

Table 8: Serum HDL and LDL in rats drinking acrylamide and treated with vitamin C

Groups		HDL (mg/dL)	LDL (mg/dL)
Control (G1)	Mean± SD	40.03±10.36	10.13±5.43
Acrylamide (G2)	Mean± SD	31.73±9.34	14.11±7.87
Acrylamide and vitamin C group(G3)	Mean± SD	23.08±13.30	19.2±8.85

P: probability (one-way ANOVA); **P1**: compared with control group; P**2**: compared with acrylamide group; P > 0.05 considered not significant, * P < 0.05 considered significant, **P < 0.01 considered high significant, and ***P < 0.0001 considered extremely significant.

Table (9): Statistical analysis of the mean of HDL and LDL in males and females of the different groups under study

Group	HDL (mg/dL)			LDL (mg/dL)		
	Mean ± SD		P value	Mean ± SD		P value
	Male	Female		Male	Female	
Control (n=12)	47.0±10.4	33.1±3.4	< 0.05*	5.4±1.8	14.8±2.9	<0.0001***
Acrylamide (n=14)	40.4±5.5	24.5±3.6	<0.0001***	7.0±2.3	21.2±3.4	<0.0001***
Acrylamide & Vitamin C (n=14)	12.0±1.5	34.2±9.6	<0.0001***	19.6±8.0	11.7±2.2	<0.0001***

P: compared between male and female; P > 0.05 considered not significant,
* P < 0.05 considered significant, **P < 0.01 considered high significant, and ***P < 0.0001 considered extremely significant.

4. Antioxidants profile

4.1. Superoxide dismutase

As shown in table 10, the mean activity of superoxide dismutase in the control group was (210.33±57.95 % inhibition) and in rats drinking acrylamide, the level was (180.71±56.18 % inhibition), moreover the levels were (155.66±68.6% inhibition) in rats drinking acrylamide treated with vitamin C. Statistical analysis (one-way ANOVA) indicated that, there was no significant difference in Superoxide dismutase level (p > 0.05) among all studied groups**.**

Statistical analysis for the differences between males and females showed that, there was no significant difference (P > 0.05) in all groups of male compared with female; **(Table 18).**

4.2. Glutathione reductase

The mean of the Glutathione reductase in rats drinking acrylamide and those drinking acrylamide and treated with vitamin C was indicated that, the mean activity of Glutathione reductase in the control group was (1.26±0.36 U/L) and in rates drinking acrylamide the level was (1.07±0.18 U/L). Moreover, the level was (1.25±0.45 U/L) in rats drinking acrylamide treated with vitamin C. Statistical analysis (one-way ANOVA) indicated that, there was no significant difference in Glutathione reductase level (p > 0.05) among all studied groups **(table 17).**

Statistical analysis for the differences between males and females showed that, there was no significant difference (P > 0.05) in all groups **(Table 18).**

4.3. Lipid peroxide (MDA)

As shown in table 17, the mean level of Lipid peroxide in control group was (29.00±7.18 nmol/g tissue), in rats drinking acrylamide, the level was (41.67±14.36 nmol/g tissue), and moreover the levels were (27.0±10.03 nmol/g tissue) in rats drinking acrylamide treated vitamin C. Statistical analysis (one-way ANOVA) indicated that, there was high significant difference in Lipid peroxide level (p < 0.01) among all studied groups Post hock test. Statistical analysis for the differences between males and females showed that, there was no significant difference (P > 0.05) in all groups of male compared with female; **(Table 19).** Statistical analysis for the differences between males and females showed that, there was very high significant difference (P < 0.001) in vitamin C group of male compared with female; **(Table 19).**

Table 10: Antioxidants profile in rats drinking acrylamide and treated with vitamin C

Groups		**SOD** (% inhibition)	**GSH** (U/L)	**Lipid peroxide** (nmol/g tissue)
Control (G1)	Mean± SD	210.33±57.95	1.26±0.36	29.00±7.18
Acrylamide (G2)	Mean± SD	180.71±56.18	1.07±0.18	41.67±14.36
Acrylamide and Vitamin C (G3)	Mean± SD	155.66±68.6	1.25±0.45	27.0±10.03

P: probability (one-way ANOVA); **P1**: compared with control group; P**2**: compared with acrylamide group; P > 0.05 considered not significant, * P < 0.05 considered significant, **P < 0.01 considered high significant, and ***P < 0.0001 considered extremely significant.

Table 11: Statistical analysis of the mean of Superoxide dismutase (SOD) and Glutathione reductase in males and females of the different groups under study

Group	Superoxide dismutase (SOD)			Glutathione reductase		
	Mean ± SD		P value	Mean ± SD		P value
	Male	Female		Male	Female	
Control (n=12)	199.5±48.3	221.2±69.1	> 0.05	1.1±0.2	1.0±0.2	> 0.05
Acrylamide (n=14)	217.4±19.0	174.2±47.8	> 0.05	1.2±0.2	1.3±0.1	> 0.05
Acrylamide & Vitamin C (n=14)	130.8±48.7	180.5±60.9	> 0.05	1.3±0.2	1.1±0.6	> 0.05

P: compared between male and female; P > 0.05 considered not significant,

Table12: Statistical analysis of the mean of Lipid peroxide content in males and females of the different groups under study

Group	Male	Female	P value
Control (n=12)	34.5±1.0	48.8±15.2	> 0.05
Acrylamide (n=14)	28.1±7.5	30.0±7.3	> 0.05
Acrylamide and vitamin C (n=14)	19.2±4.9	34.8±7.1	< 0.001**

P > 0.05 considered not significant, * P < 0.05 considered significant and **P < 0.001 considered very high significant,

DISCUSSION

ACR is an industrial chemical material that causes humans and was designated as a probable human carcinogen by IARC and USEPA. The biochemical results revealed that ACR increased Alanine amino transferase (ALT), Aspartate amino transferase (AST), triglycerides (TG), cholesterol and uric acid ACR is an industrial chemical material that causes humans and was designated as a probable human carcinogen by IARC and USEPA. The biochemical results revealed that ACR increased Alanine amino transferase (ALT), Aspartate amino transferase (AST), triglycerides (TG), cholesterol and uric acid. it causes many health hazards and The toxic effect of on the body where the results of current study agree with [10]. Serum AST and ALT are the most sensitive biomarkers used in the diagnosis of liver diseases [11]. During hepatocellular damage, varieties of enzymes normally located in the cytosol are released into the blood stream flow. Their quantification in plasma is useful biomarkers of the extent and type of hepatocellular damage[12]**.** In conjunction with previous reports[13].[14]. acrylamide group had a nonsignificant increase in LDH whencompared to control group. This result was in agreement with[15] who reported

thatacrylamide did not affect LDH activity even in different doses. That indicates thatsub-acute levels of ACR exposure over ashort period of time do not cause therelease of detectable limits of LDH[16]the results of the present investigation showed increase in serum AST and ALT activities following ACR treatment and in immature male and female rats as compared to their corresponding controls. These results confirmed by the hypothesis recorded by [17] who attributed the increase in the serum AST and ALT activities to the bipolar nature of ACR, where the CH_2=CH part may undergo hydrophobic interactions while the $CONH_2$ part can form hydrogen bonds with the cell compounds. This property may enhance its ability to alter the cell membrane structure and make the parenchymal cell membrane of liver more permeable. Albumin is a major part of the total protein (TP) made specifically by the liver. The TP levels including albumin level will be depressed in hepatotoxic conditions due to defective protein biosynthesis in the liver. Restoring the normal levels of TP including albumin is an important parameter for liver recovery [17]. The site specific oxidative damage of some of the susceptible amino acids of proteins is regarded as the major cause of metabolic dysfunction during pathogenesis In agreement with the studies of [18].[29].[20] the present study showed that ACR decreased the serum albumin level. It was reported that hypoalbuminaemia is most frequent in the presence of advanced chronic liver diseases [22] hence decline in total protein can be deemed as a useful index of the severity of cellular dysfunction in chronic liver diseases as manifested by the sever histopathological alterations of the liver tissue following ACR treatment, supplementation caused reduction of both glutathione S-transferase and glutathione peroxidase activities as well as reduced glutathione, while it significantly augmented the lipid peroxidation in brain, liver and kidneys of rabbits[23]. Vit.C participates in several rocesses that are related to collagen synthesis of hormones(noradrenaline/adrenaline and peptide hormones), synthesis of carnitine, gene transcription, and regulation of translation via different mechanisms(hydroxylation of transcription factors, tRNA and ribosomal proteins, demethylation of DNA, and histones), elimination of tyrosine, protection against reactive oxygen species(ROS), and reduction of iron in the gastrointestinal tract[24].

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CONCLUSION

The result revealed that the administration of acrylamide in drinking water significantly increased lipid peroxidation as expressed by an increase in it levels in tissues. Acrylamide is able to increase lipid peroxidation by inducing oxidative stress with generation of free radicals decrease in glutathione peroxidase Vit.C could have cell protective effects against the injury induced by Acrylamide Vitamin C assists the body in the manufacture of increase antioxidant activity and readily scavenges reactive oxygen and nitrogen species, such as superoxide and hydroperoxyl.

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