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Effect of freshwater algae on improving liver function in rats injected with carbon tetrachloride

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ABSTRACT

The term "algae" is not a phylogenetic one, but rather refers to a broad category of economically important creatures. A group of major creatures with varied ancestries, evolutionary histories, and biochemistry, algae are not a phylogenetic notion. This experimental research intends to determine repercussions of various dosages of freshwater algae on enhancing liver function in rats injected with carbon tetrachloride, since many plant-derived chemicals are used as vital raw materials in the pharmaceutical sector. The rats were housed in a cage (animal facility) for a week before to the experiment. Two groups of rats were created, with the first group (n=6) receiving only food. A 28-day baseline diet was employed as a negative control group (C-ve). Rats were given Carbon Tetrachloride (n= 24), then given 5%, 10%, and 15% freshwater algae, and a control group that tested positive for the compound. A substantial difference was seen between the GPT activity levels of groups 2 and 5, and among groups 2 and 3 and 5 and the healthy rats group, suggesting that the GPT activity levels in group 5 were the optimal therapy. There were no discernible variations among the third and fourth group-fed rats. contrasted with the placebo group, group 5 (15% freshwater algae) had the highest values for serum (T.G.). Results show that freshwater algae has a beneficial impact on hepatic rats, with the rate of improvement rising in the 10% (freshwater algae) group due to its synergistic impact for liver tissue protection from toxicity by boosting antioxidant defence capabilities.

KEYWORDS: freshwater algae, liver functions, hepatoprotective, intoxicated Rats

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INTRODUCTION

The term "algae" is not a phylogenetic one; rather, it refers to a diverse group of important organisms that share some commonalities despite their diverse ancestry, evolutionary history, and biochemistry. These organisms are often characterised by their lack of a vascular system, simple vegetative structures, and reproductive bodies lined with sterile cells, all of which make them easy to classify together **(Wehr et al ., 2015).** They may be found in both fresh and saline water and, like plants, they derive their energy from the sun. All sizes and shapes of plants are represented, from prokaryotes to eukaryotes **(Scieszka et al., 2019).** Photosynthetic pigments, starch-like reserve products, cellular covering, and other elements of cellular structure are also used to classify the various groups. **Alkhatib et al. (2017).** Around 221 species of seaweed are of economic worth due to their excellent nutritional and medicinal properties, which have traditionally been used as food or herbal remedies, among many other applications. Algae is widely used in the Chinese diet, hence its cultivation is highly developed in the country. Approximately 70 species used in Chinese cooking have been documented, but only a few have been given the green light for human consumption by the European Union. It has been shown that this occurs **(Barbier et al., 2019).** As algae have so many applications nowadays, their cultivation has increased, particularly because of the rising demand for substances obtained from algae (for use in things like cosmetics and food). Laminaria hyperborea, Laminaria digitata, and Ascophyllum nodosum are the most often harvested species of algae in Europe. Algae found in freshwater environments typically colonise submerged surfaces like rocks and mud, such as those found in rivers and streams. Chlorophyll is the main photosynthetic pigment of algae, and they do not have a sterile cell wall around their reproductive cells. Similarly, all of the transparent Prototheca listed under Chlorophyta lack chlorophyll. Blue-green algae (cyanobacteria) are technically prokaryotes, however most authorities don't include them in their definition of algae. As reported by **(Ferdouse et al., 2021)**

Roots, leaves, and other organs are found in tracheophytes, but not in algae. Phyllids (leaf-like structures) are unique to bryophytes, while rhizoids are unique to non-vascular plants (vascular plants). Most obtain their energy only from photosynthesis, but some are mixotrophic, meaning that they also obtain energy via the osmo-, myzo-, or phagotrophic absorption of organic carbon. Some unicellular green algae species, as well as many golden algae, euglenids, dinoflagellates, and other algae, have evolved into heterotrophs (also called colourless or apochlorotic algae), sometimes parasitic, which derive all of their energy from outside sources and possess little to no photosynthetic apparatus. For instance, (Mahmoud et al., 2017)

Despite the lack of knowledge on its precise mechanism, therapy may assist lessen the severity of liver disease. (Koyande et al., 2019)

The liver is the biggest internal organ in the human body. It facilitates metabolic processes including food digestion, energy storage, and toxin elimination. Liver illness can manifest in a wide variety of ways, but common signs include fluid retention (especially in the belly and legs), bruising easily, altered bowel and urinary habits, and jaundice (a yellowing of the skin and

eyes). In certain cases, no symptoms at all may be present. Imaging and liver function tests can identify liver damage and help diagnose liver diseases (Mayo Clinic et al., 2022).

THE PURPOSE OF THE STUDY:

The study set out to assess the impact of various dosages of freshwater algae on rat liver function after carbon tetrachloride injection.

MATERIALS

Freshwater Algae

The freshwater algae were bought as dried material from a local shop

Diets

The Basic Diet

- Casein (ten percent), maize oil (ten percent), vitamin mix (one percent), salt mix (four percent), choline chloride (two-tenths of one percent), methionine (three-tenths of one percent), cellulose (five percent), and corn starch (sixty-nine point five percent) made up the basel diet. Source **Reeves et al (1993).**
- CaCO3 (six hundred mg), K2 HPO4 (645 mg), Ca HPO4. 2H2O (150 mg), MgSO4.2H2O (204 milligram), NaCl (334 milligrames), Fe (C6H5O7) 26H2O (fifty-five mg), Kl (1.6 mg), MnSO4.4H2O (ten mg), ZnCl2 (five-tenths of one mg), and Cu SO4.5H2O (0.06 mg) were all included in the test diet's base Source **(Hegsted et al., 1941). (Hegsted et al., 1941).**
- Vitamin E (10 IU), Vitamin K (0.5 mcg), Vitamin A (two hundred IU), Thiamin (0.5 mcg), Pyridoxine (1 mcg), Niacin (four mcg), Ca pantothenate (0.4 mcg), Vitamin D (one hundred IU), Choline chloride (two hundred mg), Inositol (twenty-four mcg), Folic acid (0.02 mcg), Para-aminobenzoic acid ((0.02 mg), **(Campbell, 1963)**
- **Experimental diet**

Table (1): The composition of the baseline and experimental diets:

Component (g)	Basal diet	Basal diet +5% Freshwater algae	Basal diet +10% Freshwater algae	Basal diet +15% Freshwater algae
Test ingredients	-	5	10	15
Casein	20	20	20	20
Corn oil	4.7	4.7	4.7	4.7
Mineral mix	3.5	3.5	3.5	3.5
Vitamin mix	1	1	1	1
Cellulose	5	5	5	5
Choline chloride	2	2	2	2
Sucrose	10	10	10	10
Corn starch	Up to 100	Up to 100	Up to 100	Up to 100

Carbon tetrachloride (Ccl4)

The El-Gomhoria Company for Chemical Industry donated (Ccl4) to Cairo, Egypt. A 10% liquid solution was given to them. According to ***(Passmore & Eastwood, 1986),*** *it was distributed as a hazardous material component for liver illness and was packaged in white plastic water bottles with a capacity of one litre. In the induction phase, it is diluted with paraffin oil bought from a drug store.* ***(Passmore & Eastwood, 1986).***

Rats

Thirty mature male Sprague-Dawley rats weighing 150-160 g B.Wt. were used. These rats were fourteen-sixteen weeks old. The animals were confined to filthy circumstances, in plastic pens without proper ventilation or a roof. The baseline diet was provided to rats for 7 days before to the investigation, allowing them to adjust. Ad libitum water was delivered through a small-mouth bottle attached to a metallic tube and a plastic tubing at the mouth. During7 days before the commencement of the investigation, the rats were acclimated to a 12-h light/12-hr dark cycle, as was previously mentioned.

METHODS

Preparation of plant

Dry freshwater algae was purchased from a vendor in al Baha, Saudi Arabia. All plant materials were ground up in a blender and kept in a dark-capped glass jar in the fridge until needed. accordance with Russo (2001), all herbs and plants must be maintained in a cool , dark, and dry environment to avoid oxidation. According to Jayasekhar et al., 20 male albino rats were given(2ml / kg b. wt.) of (Ccl4) in fifty percent V/V paraffin oil twice weekly for 2 weeks to induce chronic liver damage (1997). To test for liver disease and assess liver function, blood was drawn through a retro-orbital route after Ccl4 injection.

Rats are grouped and fed.

The rats utilised in the investigation were 30 Sprague Dawley white male albino rats weighing between 150 and l60 grammes. There were six rats in each of the five groups. The rat groupings are as follows:
• Group (1): Rats were provided a regular diet in the -ve placebo trial (placebo "-").
• Group (2): The placebo +ve group (placebo "+") was made up of rats fed a regular diet and given (CCl4).
• Group (3) was fed a regular meal supplemented with 5% freshwater algae.
• Group (4) was fed a regular diet supplemented with 10% freshwater algae.
• Group (5) was fed a regular meal supplemented with 15% freshwater algae.

Blood sampling
Then, ether-anesthetized rats were slain in preparation for further experiments (28 days). Blood samples have been gathered via the retro-orbital route and placed in a sterile centrifuge tube. After letting them congeal at room temperature for a few hours, they were centrifuged for fifteen minutes at 1500 pm. using a sterile syringe, serum was drawn and stored in Wasserman tubes at -10 °C for further biochemical analysis. Organs from the rats were removed, cleaned in saline, weighed, and dried. This included the livers, spleens, lungs, hearts, and kidneys. The following method was used to derive the weight values of the aforementioned organs. Organs were preserved in formalin (ten percent V/V) before histological investigation, as described by Drury & Wallington (1967).

Biological evaluation:
According to Chapman D.G., the feed efficiency ratio (FER), food intake (consumption), bodyweight gain percent (BWG percent), and FER all have a direct impact on one another (1959). In this case, the following formula will be used.

$$BWG\% = \frac{Final\ weight - Initial\ weight}{Initial\ weight} \times 100$$

$$FER = \frac{Gain\ in\ body\ weight\ (g\ /\ day)}{Food\ Intake (g\ /\ day)}$$

$$\text{The organs' relative weight} = \frac{\text{Organs weight}}{\text{Animal body weight}} \times 100$$

Biochemical analysis
The function of liver enzymes
(AST) enzyme activity was measured utilising a spectrometer and specific kits (BioMerieux), as per the protocol outlined by ***Reitman and Frankel (1957).*** *(ALT) activity: The ALT enzyme activity was evaluated by colorimetric method described. It was first proposed in 1957 by Reitman and Frankel. (ALP) concentration were measured with a colorimetric test using the* ***Roy method (1970).*** *The total bilirubin concentration in the serum was assessed calorimetrically, using the method published by* ***Doumas et al (1973).*** *A spectrophotometer set to 578 nm was used to measure total cholesterol in the blood* ***(Ratliff & Adams, 1973).***
Determination of triglycerides:
Jacobs & Van-Denmark (1960) determined the triglyceride concentration with an enzymatic colorimetric method. The HDL concentration was determined via **(Jacobs & Van-Denmark, 1960).** VLDL and LDL levels were calculated using **(Lee, 2009).**
Analytical statistics
Statistical analysis was performed with the help of the computer application SPSS (Statistic Program statistical software, SAS Institute, Sigmastat, Cary, NC). (ANOVA) and Duncan's multiple tests were used to establish whether or not there was a statistically significant distinction among the groups as a result of the treatments $p<0.05$ (Snedecor and Cochran, 1967).

- **Ethical Approval**

The Science Research Ethics Committee of the Faculty of Home Economics accepted the protocol of the research #15-SREC-06-2025.

RESULTS AND DISCUSSION

Biological effects
Effect of different level of ***freshwater algae*** *on* ***body weight*** *BWG %, of Hepatointoxicated rats.*
Data in Table (2) showed the impact of freshwater algae on weights of negative control and treatment groups. At the beginning of experiment There were no noteworthy variances was observed in initial weight among all groups, treatment groups reduced final weight in treatment groups in contrast to negative group. These results were agree with Alghamdi, (2020) who CBZ administration led to a considerable reduction in BWG in mice.This reduction in BW may be ascribed to a reduction in food consumption and/or a rise in protein and lipid breakdown. There were no substantial variations in final weight among rats feed (5%.10% and 15%) freshwater algae. This result correspond to **(Bocanegra *et al.*, 2009)** who showed that administration of freshwater algae crude ethanol extract, improved the body weight gain. Furthermore,. The increase in change of weight in rats supplemented with 5%, 10% and 15% freshwater algae was 28.19 , 24.32, and 21.52 respectively . The results indicated that administration of 15% freshwater algae rats had more effective ($p < 0.05$) for improvement the weight loss as compared with other groups.

Table (2): Implications of feeding dissimilar amounts of on Freshwater algae weight in of Hepatointoxicated rats. Mean±SD

Parameters / Groups	First weight(g)	Final weight(g)	% Change
G1: Control (-ve)	267.33^{b}±10.32	291.16^{a}±6.6	8.18
G2: Control (+ve)	295.80^{a}±1.9	208.16^{dc}±11.1	42.10
***G3:* 5% freshwater algae**	266.00^{b}±2.1	213.95^{cd}±13.5	28.19
***G4:10%* freshwater algae**	273.33^{b}±2.5	219.16^{cd}±7.9	24.32
***G5: 15%* freshwater algae**	264.11^{b}±3.1	217.33^{cd}±9.0	21.52

Different letters Within the same row indicate substantially various means. ($p < 0.05$).

The impact of different concentrations of different amounts of Freshwater algae on the relative organ weight of Ccl4–intoxicated rats.

Data in Table (3) showed the impact of freshwater algae on relative organ weights of negative control and treatment groups. Relative organs in +ve placebo were significantly increased when contrasted to a placebo group. This outcome conforms with (**Stancakova *et al* .,2016)** who discovered that rats given with carbendazim for 90 days showed significant increase in relative liver and kidney compared with negative group. Administration rats with freshwater algae extracts did not differ in their effect on relative organs weigh. (**Sharma *et al.*, 2019)** reported that the greatest drop in limit achieved for freshwater algae 7.5% in liver, kidneys and lungs weights(g) & (freshwater algae 7.5%) in heart and spleen weights (g).

Table (3): The effect of various amounts of Freshwater algae on the relative organ weight of Ccl4–intoxicated rats.

Parameters / Groups	G1: Control (-ve)	G2: Control (+ve)	G3: 5% freshwater algae	G4: 10% freshwater algae	G5: 15% freshwater algae	LSD (P<0.05)
ALT (U/L)	36.66^{c}±0.21	44.55^{a}±0.51	42.02^{b}±0.46	40.29^{c}±0.33	39.2^{d}±0.72	0.90
%Change	-17.71	-	-5.67	-9.56	-12.0	
ALP (U/L)	184^{c}±1	296.55^{a}±0.51	234.83^{b}± 0.76	227.86^{c}±1.02	202.55^{d} ± 0.51	1.56
%Change	-37.95	-	-20.81	-23.16	-31.69	
AST (U/L)	129.29^{d}±0.28	184^{a}±1	181^{b} ±1	179.52^{b} ± 0.71	169.15^{c} ± 0.78	1.56
%Change	-29.73	-	-1.63	-2.43	-8.07	
T. Billi (mg/dl)	0.29^{c}±0.001	0.48^{a}±0.015	0.46^{b}±0.004	0.37^{c}±0.003	0.30^{d}±0.006	1.56
%Change of	-39.58	-	-4.16	-22.91	-37.5	

The impact of different concentrations of different amounts of Freshwater algae on hepatic enzymes (AST, ALT, and ALP).

- The data shown in Table (4) represent the mean value of serum (ALT) (U/L) of hepatic rats given varying quantities of freshwater algae. It was noticed that the mean value of (ALT) in the placebo (+) group was greater than that of the placebo (-) group (44.55 ±0.5l and 36.66 ±0.21 mg/dL), demonstrating a substantial variation with a drop of -17.71% in the placebo (-) group contrasted with the control (+) group. Contrasted with the (+) placebo group, the mean values of all hepatic rats given varying quantities of freshwater algae declined substantially. The results for (5%, 10%, and 15% Freshwater algae) were 42.02 ±0.46, 40.29±0.33, and 39.2±0.72 U/L, respectively. The percentage of declines for groups 3, 4, and 5 were -5.67, -9.56, and -12.0%, respectively, and the best treatment in terms of the GPT was in group 5 activity, which demonstrated a noticeable difference compared to the group of healthy rats. Group 5 was shown to have numerically the best therapy. According to the findings of (Samira et al., 2021), C. vulgaris supplementation substantially lowered ALT levels (WMD, 4.65 U/L; 95% CI, 8.88, 0.42) contrasted with placebo, but not metformin consumption.

The data in table (4) demonstrate the mean value of serum (ALP) (U/L) of hepatic rats given varying quantities of freshwater algae. The mean value of (ALP) of the placebo (+) group was greater than that of the placebo (-) group, which was 296.55 ±0.51 and 184 ±1.00 , respectively, indicating a statistically substantial variation with a drop of -37.95% in the placebo (-) group contrasted with the placebo (+) group. All of the hepatic rats were given varying quantities of freshwater algae. Compared to the (+)placebo group, it exhibited substantial declines in mean values. Its values were234.83±0.76, 227.86 ±1.02 and 202.55 ±0.51U/L for 5%, 10%, and 15% freshwater algae, respectively. For each group, the respective drop percentages were -20.81, -23.16, and -31.69%. Compared to the placebo (-), rats fed on all groups exhibited substantial variations between them. Quantitatively, the therapy of serum ALP in group 5 was superior.

The mean value of serum (AST) (U/L) of hepatic rats fed varying quantities of freshwater algae is depicted in Table 4. It. The mean value of (GOT) in the placebo (+) group was greater than in the control (-) group,184.00±1and 129.29±0.28 respectively, demonstrating a substantial variation with a drop of -29.73% in the placebo (-) group as juxtaposed with the placebo (+) group. The mean values of all hepatic rats given various diets declined substantially compared to placebo group (+). 181.0 ±1, 179.52 ±0.71, andl69.15±0.78 U/L were the measured values. For 5 percent, 10 percent, and 15 percent freshwater algae). It. specifically The percentage declines for groups 3, 4, and 5 were -1.63, -2.43, and -8.07 percent, respectively. This indicates that there were no statistically substantial variation among the rats in groups 3 and 4. Group 5(15% freshwater algae was shown to be the best therapy. It)when contrasted with the placebo group (-) when (GOT) activity is considered. Indicators of liver function, such as AST and ALT activity, were unaffected by diets containing 5% freshwater algae. It. These statistics align with those

reported by (Haidari et al ., 2018) It appears that C. vulgaris supplementation has a greater impact on AST levels than ALT and ALP levels; however, as previously stated, the effect of C. vulgaris on these enzymes may be context-dependent. Hence, more research with a large number of cases and on a variety of illnesses is required and can give more conclusive proof.

In addition, results shown in table (4) revealed the mean serum T.Billi concentration (mg/dl) of rats with hepatic disease fed a variety of diets. It was noticed that the mean value of T.Billi. for the control (+) group was greater than that of the placebo (-) group 0.48±0.015and 0.29 ±0.001 respectively, indicating a substantial variation with a drop of -39.58% in the placebo (-) group in comparison to the placebo (+) group. contrasted with the (+)placebo group, the mean values of all rats with a hepatic diet provided at varying levels decreased significantly. The concentrations were 0.46 ±0.004, 0.37±0.003 and 0.30 ±0.006 mg/dl. For (5 %, 10 %, and 15 % of freshwater algae, respectively). For groups 3, 4, and 5, the respective percentage declines were -4.16, -22.91, and -37.5. When compared to healthy rats, animals fed each of the four groups exhibited substantial differences. The group "5" (15 percent freshwater algae) was the most effective therapy in terms of the T.Billi serum.

Table (4): The impact of various amounts of Freshwater algae on liver functions of Ccl4–intoxicated rats.

Parameters / Groups	liver (%)	Heart (%)	kidneys (%)	Spleen (%)	Lungs (%)
G1: Control (-ve)	4.31^{a}±0.81	0.43^{a}±0.07	0.98^{a}±0.09	0.39^{a}±0.07	0.76^{a}±0.16
G2: Control (+ve)	2.40^{bc}±0.44	0.33^{ab}±0.06	0.64^{bc}±0.09	0.25^{b}±0.10	0.67^{ab}±0.11
G3 :5% freshwater algae	2.51^{bc}±0.41	0.27^{a}±0.10	0.63^{b}±0.20	0.26^{b}±0.13	0.56^{bc}±0.20
G4: 10% freshwater algae	2.61^{bc}±0.37	0.35^{abc}±0.05	0.61^{bc}±0.14	0.28^{ab}±0.04	0.66^{ab}±0.09
G5: 15% freshwater algae	3.02^{b}±0.59	0.33^{bc}±0.06	0.75^{ab}±0.13	0.38^{a}±0.07	0.70^{ab}±0.13

The impact of different amounts of Freshwater algae on (TC, mg/dl, TG, mg/dl, HDL, mg/dl and LDL, mg/dl) of Ccl4–intoxicated rats.

Tabulate the mean serum (T.C.) concentration (mg/dL) of rats with hepatic disease that were fed varying quantities of freshwater algae. It was observed that the mean value of (T.C.) in the placebo (+) group was greater than that of the placebo (-) group, which was86.18±1.02 and 70.33 ±0.33 respectively, exhibiting a statistically significant decline with a drop of -18.37% in the placebo (-) group juxtaposed with the placebo (+) group. Contrasted with the (+) placebo group, the mean values of all hepatically-impaired rats given varying quantities of freshwater algae were significantly lower in all cases. The results were 65.57±0.66, 72.84 ±0.78 and 70.78±0.48 mg\dl. for (5 percent, ten percent, and fifteen percent freshwater algae) correspondingly. The respective percentage declines for groups 3, 4, and 5 were -23.89%, -15.45%, and -17.85%. All rats fed on groups exhibited substantial variations among them. Likewise, rats in group 5 exhibited substantial differences. in contrast to the placebo (-) group. juxtaposed with the placebo (-) group, group 3 (5% freshwater algae) had numerically superior serum (T.C). (Salma et al., 2018) found that freshwater algae lowered total lipids, total bilirubin, triglycerides, and cholesterol, particularly in the UL and PC groups, and similarly HDL. The current findings are consistent with these findings.

Contrasted with the CA and placebo groups, the UL, PC, and SP groups had decreased LDL values. Table (5) displays the mean serum (T.G.) concentration (mg/dl) of rats with hepatic disease that were fed varying quantities of freshwater algae. The mean value of (T.G.) of the placebo (+) group was greater than that of the placebo (-) group, which was 71.073 ±1.32 and 56.33 ±0.33respectively, suggesting a substantial variation with a drop of -20.74% in the placebo (-) group Contrasted with the placebo (+) group. The mean readings of all hepatic rats given varied meals were significantly lower than those of the placebo group (+). The results were 69.74 ±1.09, 69.76±0.68 and 59.11 ±0.84 mg/dL. For (5 percent, 10 percent, and 15 percent) freshwater algae, respectively. The relative percentage declines for groups 3, 4, and 5 were -1.87, -1.84, and -16.83%. Rats fed in groups 3 and 4 exhibited insignificant differences. juxtaposed with the placebo (-) group, the serum (T.G.) for group 5 (15 % freshwater algae) was numerically superior.

Furthermore indicate in table (5) the mean serum (H.D.L.c) concentration (mg/dL) of hepatically compromised rats fed varying quantities of freshwater algae. It was noticed that the mean value of (HDLc) in the placebo (+) group was lower than that of the placebo (-) group (18.29 0.33 vs. 22.52 0.51 respectively), demonstrating a statistically substantial variation with a percent increase of 23.12% in favour of the placebo (-) group. Contrasted with the (+)placebo group, the mean values of all rats with a liver that were fed varied diets increased significantly. The results were 20.03 ±0.27, 21.21 ±0.61 and 21.5±0.5 mgdl for (5%,10%, and 15% freshwater algae), respectively. The percentage of increases was±9.51 , ±15.96 and ±17.55 % for the same categories indicated before. The rats in groups 4 and 5 did not vary significantly from one another in comparison to the placebo group (-). Contrasted with the placebo placebo group (-), groups 4 and 5 (10% and 15% freshwater algae) had the highest HDLc levels.

In the same table (5), display the mean value of serum (LDLc) (mgdl) of hepatic rats given varying quantities of freshwater algae. It was observed that the mean value of (LDLc) in the control (+) group was greater than that of the placebo (-) group, being 53.650.98 and 36.340.34 respectively, demonstrating a statistically significant distinction with a decrease of -32.26% in the placebo (-) group in comparison to the placebo (+) group. As comparison to the (+)placebo group, the mean values of all hepatic rats given varied diets declined substantially. The results were 31.58 ± 1.21, 37.7 ±0.2 and 37.4± 0.4 mg/dl for 5%, 10%, and 15% of freshwater algae, respectively. For groups 3, 4, and 5, the respective percentage declines were -41.13, -29.72, and -30.28. Compared to the placebo (-) group, rats from groups 4 and 5 did not vary significantly from one another. The best serum levels were seen in rats given group 3 (5% freshwater algae) (LDLc). ProAlgaZyme resulted in statistically significant($p < 0.001$)reductions in weight, body fat, total cholesterol, LDL-cholesterol, triglycerides, C-reactive protein, and fasting blood glucose levels, accompanied by a statistically significant ($p < 0.001$ increase in HDL-cholesterol levels over a 10-week study period. There were no adverse reactions to the infusion.

Table (5): The impact of various quantities of Freshwater algae on (TC, mg/dl, TG, mg/dl, HDL, mg/dl and LDL, mg/dl) of Ccl4–intoxicated rats.

Parameters / Groups	G1: Control (-ve)	G2: Control (+ve)	G3: 5% freshwater algae	G4: 10%freshwater algae	G5: 15% freshwater algae
T. C (mg/dl)	70.33^{c} ±0.33	86.16^{a} ±1.02	65.57^{e}±0.66	72.84^{b}±0.78	70.78^{c}±0.48
%Change	-18.37	-	-23.89	-15.45	-17.85
T. G (mg/dl)	56.33^{c} ±0.33	71.07^{a} ±1.32	69.74^{a}±1.09	69.76^{a}±0.68	59.11^{b}±0.84
%Change	-20.74	-	-1.87	-1.84	-16.83
HDL (mg/dl)	22.52^{a} ±0.51	18.29^{c} ±0.33	20.03^{c}±0.27	21.21^{b}±0.61	21.5^{b}±0.5
% Change	23.12	-	9.51	15.96	17.55
LDL (mg/dl)	36.34^{b} ±0.34	53.65^{a} ±.0.98	31.58^{d}±1.21	37.7^{b}±0.2	37.4^{b}±0.4
% Change	-32.26	-	-41.13	-29.72	-30.28

The impact of different amounts of Freshwater algae on (Uric acid, mg/dl ,Creatinine, mg/dl, and Urea, mg/dl) of Ccl4–intoxicated rats.

The table (6) data illustrate the mean serum urea concentration (mg/dl) of rats with hepatic disease that were given varying doses of freshwater algae. The mean value of urea in the placebo (+) group was greater than that of the placebo (-) group, which was 26.6 ±0.36and 18.18 ±0.16 mg/dl respectively, suggesting a substantial variation with a drop of -31.65% in the placebo (-) group in comparison to the placebo (+) group. When juxtaposed with the (+)placebo group, the mean values of all hepatic rats given varying quantities of freshwater algae decreased significantly. The readings were 25.33±0.30 mg/dl (5%),21.41±0.18mg/dl (10%), and 20.55±1.50 mg/dl (15%), respectively. All of the aforementioned categories had corresponding declines of -4.77, -19.51 and -22.96 percent. Rats fed on all three groups exhibited notable variations between them. Additionally, all groups displayed statistically substantial variation when Contrasted with the placebo group (-). Comparing group 5 (15 % freshwater algae) to the placebo (-) group of serum urea, group 5 (15 %) yielded the best numerical results.

Also shown in table (6) is the mean serum creatinin concentration (mg/dl) of rats with hepatic disease that were fed varying quantities of freshwater algae. It was discovered that the mean value of creatinine in the placebo (+) group was greater than that of the placebo (-) group, 0.74 ±0.04 and 0.59 ±0.02 respectively, with a substantial variation of -24.32% for the placebo (-) group. As comparison to the (+) placebo group, the mean values of all hepatic rats given varied diets decreased significantly. The results were 0.65 ±0.01, 0.64±0.01 and 0.63±0.01mg/dl for algal concentrations of 5%, 10%, and 15%, respectively. Groups 3, 4, and 5 had corresponding declines of -12.16, -13.51, and -14.88%. Rats fed groups 3, 4, and 5 exhibited non substantial variation among them, and group 5 (15% freshwater algae) was quantitatively the best treatment contrasted with the placebo group (-). The current information corresponds to what was reported by (Lidia et al ., 2022). After administering nephropathy treatment to mice, a substantial improvement in kidney function was found. The blood levels of creatinine and urea were drastically decreased following treatment with a low dosage (150 mg/kg) of the green microalgae C. sorokiniana. Treatment with a high dose of the drug lowered blood uric acid concentrations by a statistically significant amount . All the assessed kidney parameters responded substantially to low-dose therapy juxtaposed with the -ve control when juxtaposed with urine samples analysed using the same methodology. There were no substantial variations among the results acquired following low-dose treatments and those treated with high doses. Figure 1 compares the concentrations of uric acid, creatinine, and urea in all of the test groups.

The table's results (6) Display the mean value of serum (U. A) (mg/dl) in hepatic rats given varying quantities of freshwater algae. It was discovered that the mean value of uric acid in the placebo (+) group was greater than that of the placebo (-) group1.72 ±0.025 and 1.30 ±0.015 mg/dl respectively showing a substantial variations with a drop of -24.41% in the control (-) group in comparison to the placebo (+) group. As comparison to the (+) placebo group, the mean values of all hepatic rats given varied diets decreased significantly. The results for (5%,10%, and 15%) freshwater algae were 1.67 ±0.025, 1.41 ±0.01 and 1.35 ±0.015 mg/dl, respectively. For (5%,10%,and 15% freshwater algae), the proportional declines in percentage were -2.90, -18.02, and 21.50 percent. Rats fed on all three groups exhibited notable variations between them. Contrasted with the placebo placebo (-) group, the numerically superior therapy was found in group 5.

Table (6): The impact of different amounts of Freshwater algae on (Uric acid, mg/dl ,Creatinine, mg/dl, and Urea, mg/dl) of Ccl4–intoxicated rats.

Parameters Groups	G1: Control (-ve)	G2: Control (+ve)	G3: 5% freshwater algae	G4: 10% freshwater algae	G5: 15% freshwater algae
Urea (mg/dl)	18.18^{c}±0.16	26.6^{a}±0.36	25.33^{b}±0.30	21.41^{c}±0.18	20.55^{d}±0.50
%Change	-31.65	-	-4.77	-19.51	-22.96
Creatinine (mg/dl)	0.59^{d} ±0.02	0.74^{a}±0.04	0.65^{b}±0.01	0.64^{b}±0.01	0.63^{b}±0.01
%Change	-24.32	-	-12.16	-13.51	-14.88

Uric acid (mg/dl)	1.30^{e}±0.015	1.72^{a}±0.025	1.67^{b}±0.025	1.41^{c}±0.01	1.35^{d}±0.015
% Change	-24.41	-	-2.9	-18.02	-21.51

The impact of different amounts of Freshwater algae on (serum glucose) of Ccl4–intoxicated rats.

The mean blood glucose concentration (mg/dl) of rats with hepatic disease that were fed varying doses of freshwater algae was presented in Table 7. The mean value of glucose in the placebo (+) group was greater than in the control (-) group, 177.03±0.35 and 89.43±0.66 respectively, indicating a significant difference and a drop of 49.48% Contrasted with the placebo (+) group. In comparison to the (+) control group, the mean values of all hepatic rats given varying quantities of freshwater algae decline significantly. For groups 3, 4, and 5, the corresponding values were169±1, 168.06±1.36 and 138.41±0.52 mg\dl. All groups saw corresponding percentage declines of -4.53, -5.06, and -21.81 The rats in groups 3 and 4 did not vary significantly from each other Contrasted with to the placebo group (-). Compared to the placebo (-) group, group 5 (15 % freshwater algae) had significantly lower blood glucose levels. These numbers are consistent with what has been reported by (Hannon et al ., 2020) dietary fibre and polyphenols are among the most extensively investigated algae components for regulating glucose homeostasis, as evidenced by the findings. In fact, recent research links the consumption of dietary fibre and polyphenols to the prevention and control of T2DM. In Korea and Japan, seaweeds are an important part of the daily diet, and there is considerable evidence that a diet rich in algae and food items derived from algae is connected with a lower prevalence ofT2DM in people.

Table (7): The impact of various amounts of Freshwater algae on (serum glucose) of Ccl4–intoxicated rats.

Parameters / Groups	G1: Control (-ve)	G2: Control (+ve)	G3: 5% freshwater algae	G4: 10% freshwater algae	G5: 15% freshwater algae
Glucose (mmol/dl)	89.43^{d}±0.66	177.03^{a}±0.3	169^{b}±1	168.06^{b}±1.36	138.41^{c}±0.52
%Change	-49.48	-	-4.53	-5.06	-21.81

CONCLUSIONS AND RECOMMENDATIONS

The results indicate that freshwater algae has a positive effect on the enzymatic liver of hepatic rats, with the rate of improvement increasing in the 10% (freshwater algae) group due to the discovery of a synergistic impact on protecting liver tissues from damage by boosting antioxidant defences.cases may thus use these extracts as dietary supplements in multiherbal formulations. It might be suggested that:

- Patients with hepatitis should consume freshwater algae.
- The varying amounts of freshwater algae, namely 5%, are beneficial to hepatic patients.
- Diverse dosages of freshwater algae may be recommended for decreasing LDL and the atherogenic index.

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