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The effectiveness of the char plant (Solenostemon Leaves) in improving lipid and kidney function in rats suffering from oxidative stress

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ABSTRACT

It is now widely accepted that oxidative stress & lifestyle-associated illnesses are closely related. Oxidative stress is defined as an imbalance among the production of reactive oxygen species, also known as free radicals, and the defenses that are given by antioxidants. this research aims to determine the efficacy of the char plant (Solenostemon Leaves) in improving lipid profile, kidney function, & antioxidant enzymes in rats suffering from oxidative stress. The investigation was conducted within an animal home. Before beginning the experiment, all mice were provided with a basal diet for one week. They were then separated into two primary groups. The first group, consisting of six rats, served as the control negative (C-ve) normal rats & was only fed the basal diet for an interval of twenty-eight days. The second main group received a solitary intraperitoneal dosage of potassium bromate& was then separated into four groups. Three of these groups were provided with char plants at varying concentrations (5%, 10%, and 15%), while one group served as a control and was infected with the disease but didn't eat the experimental diet. The findings indicated that G3 (a five percent char plant) exhibited the most significant reduction in serum triglyceride (TG) levels (milligrams per deciliter), while all mice fed experimental diets (G4, G3, and G5) demonstrated significant reductions in serum creatinine. Also, Group 5 (15% char plant) revealed a higher increase in SOD activity compared with the control (+) group. The research recommends adding leaves of the char plant to diets at certain concentrations to improve biological functions (lipid profile and kidney function).

KEYWORDS: Solenostemon Leaves - Antioxidants enzymes - lipid profile- oxidative stress.

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INTRODUCTION

It is now common knowledge that oxidative stress and lifestyle-associated illnesses are closely related. The condition known as oxidative stress takes place when there is an imbalance among the generation of reactive oxygen species, also known as free radicals, & the protections provided by antioxidants. **(Yoshikawa & Naito, 2002).** Oxidative stress occurs when there is a disparity between the quantity of reactive oxygen species present in a biological system and the system's capacity to efficiently eliminate these reactive substances or restore the consequent harm. Toxicity can result from changes in the normal redox state of cells, which generate peroxides & free radicals that inflict harm upon all cellular constituents, such as DNA, lipids, & proteins. Oxidative stress induced by oxidative metabolism leads to DNA strand breaks and base damage. Reactive oxygen species such as oxygen (superoxide radical), #OH (hydroxyl radical), & H2O2 (hydrogen peroxide) primarily induce indirect base damage. Moreover, in redox signaling, certain reactive oxidative species function as cellular mediators. Therefore, it is possible for oxidative stress to induce disturbances in regular cellular signaling pathways **(Joseph et al., 2015).** The human body has developed a defense mechanism to counteract the current concentration of free radicals, which serves as a safeguard against harm to cells. These methods may involve both direct and indirect physiological processes. **(Engwa, 2018).** Vegetables have historically been ingested for their vitamin and nutrient content, which are all beneficial to the body. In addition, numerous plants were utilized for therapeutic purposes in traditional medicine. Despite these applications, the concept of plants serving as antioxidant sources has gained importance in recent years, given that oxidative stress is recognized as a significant factor in the majority of human diseases & the antioxidant defense system is frequently inadequate to counteract the free radical level in the body. Consequently, plants have garnered significant attention as potential sources of antioxidants, prompting extensive research endeavors to identify plant compounds that exhibit antioxidant properties **(Agbor et al., 2021).** The leaves and extracts of the char plant are extensively utilized in traditional medicine for their beneficial properties as antioxidants, anti-diabetic agents, vermicides, emmenagogues, & hypolipemic agents. In addition to their various applications in wound healing, they are also utilized as anti-edematous and anti-inflammatory compounds to promote the recovery of soft tissue injuries. Furthermore, they find use in the treatment of arthritis, hematoma, necrotic tissue, & hematoma **(Iheagwam et al., 2019).**

The extract of char leaves reduces the proportion of LDL, a possible risk factor for cardiovascular illnesses. Therefore, it potentially reduces the atherogenic index by enhancing the catabolism of LDL via hepatic receptors **(Sinaga et al., 2018).** Additionally, this plant is rich in fiber. A rise in dietary fiber appears to be associated with a reduction in blood cholesterol levels, which subsequently mitigates the risk of heart disease. Increasing fiber consumption has comparable beneficial effects on other conditions, including diabetes & constipation. Multiple studies, as reported by the Harvard School of Public Health, demonstrate that an increase in fiber consumption reduces the risk of metabolic syndrome, which comprises elevated triglyceride levels, hypertension, and insulin resistance **(Dabija et al., 2018).** According to a study **(Edelman et al., 2016),** the leaves of the char plant possess potent antioxidant and bromelain properties. Furthermore, they were found to enhance cardiac systolic and diastolic

dysfunction induced by isoproterenol and preserve cell membrane integrity. It effectively mitigated the extent of myocardial injury & counteracted the oxidative stress induced by isoproterenol in rats to a significant degree. The researchers discovered that the extract of char plant leaves increased HDL levels in the obese group, suggesting that pineapple may have the potential to lower the risk of lipid-associated illnesses **(Du et al., 2021).**

AIM OF STUDY

This work targeted the effectiveness of the char plant (*Solenostemon* leaves) in improving lipid profile, kidney function, & antioxidant enzymes in rats suffering from oxidative stress.

MATERIALS AND METHODS:-

1- Materials:

A- preparation of char plant (Solenostemon leaves): A *dried Solenostemon leaves* plant, commonly referred to as char plant, was procured from the local market in Al Baha City, Saudi Arabia. The specimen underwent meticulous washing, followed by precise slicing into minute fragments. Subsequently, it was subjected to dehydration in a drying oven maintained at a constant temperature of fifty degrees Celsius for a period of three days. Finally, the dried fragments were finely pulverized into a powder.

B-Experiraental animals: The study utilized a sample of 30 male albino rats from the Sprague Dawley strain, with an average weight of 150±10g.

C-Used chemicals: A white substance containing potassium bromate (KBrO3) was acquired from El-Gomhoria Company for Drugs & Medical Equipments, located in Cairo, Egypt.

-.2- Methods:

A- biological experiment

Basal diet composition of mice:

In the experiment, the basal diet comprised the following components: casein (ten percent), starch (69.5 percent), corn oil (ten percent), salt mixture (four percent), vitamin mixture (one percent), methionine (0.3 percent), choline chloride (0.2 percent),& cellulose (five percent).**Campbell, (1963)** (Table 1).

Table (1): **Composition of basal diet:**

Ingredients	**Amounts(%)**
Corn oil	10
Protein (casein)	10*
Vitamin mixture	1
Choline chloride	0.2
Mineral mixture	4
Cellulose	5
Corn starch	above 100
Methionine	0.3

Reeves *et al.*, (1993).

The data presented in Table 2 The test's baseline diet consisted of the following: CaCO3 (600 milligrams), Ca HPO4. 2H2O (150 milligrams), K2 HPO4 (645 milligrams), Nacl (334 mg), MgSO4.2H2O (204 milligrams), Kl (1.6 milligrams), Fe (C6H5O7) 26H2O (55 milligrams), Zncl2 (0.5 milligrams), MnSO4.4H2O (10 milligrams), & Cu SO4. 5H2O (0.06 milligrams). Hegsted et al. (1941). (Table 2).

Table 2: The components that make up the salt combination (g/100 g)

Compounds	**Amount(mg)**
K_2HPO_4	645
$CaCO_3$	600
$MgSO_{4.2}H_2O$	204
Ca $HPO_{4.}$ $2H_2O$	150
Fe (C6H5O7) 26H2O	55
Nacl	334
$MnSO_4.4H_2O$	10
Cu $SO_{4.}$ $5H_2O$	0.06
Kl	1.6

$Zncl_2$	0.5

Source: **(Hegsted *et al.*, 1941).**

Table 3 shows that the basal diet in the test comprised Vit K (0.50 international units), Vit E (10 international units), Thiamin (0.5 milligrams), Vit A (200 international units), and Niacin (4 milligrams). Calcium pantothenic acid (0.40 milligrams), Pyridoxine (1 milligram), Choline chloride (200 milligrams), Vitamin D (100 international units), Inositol (24 milligrams), Folic acid (0.02 milligrams), and Vitamin B12 (2 micrograms) Para-amino-benzoic acid (0.02 milligram) **(Campbell, 1963). (**Table 3)

Table (3): The composition of vitamin mixture

Vitamin	**Amount**
Vit K	0.50 international unit
Vit E	10 international unit
Thiamin	0.50 milligram
Vit A	200 international unit
Niacin	4 milligrams
Pyridoxine	1 milligram
Calcium pantothenic acid	0.40 milligram
Vit D	100 international unit
Folic acid	0.02 milligram
Choline chloride	200 milligrams
Para-amino – benzoic acid	0.02 milligram
Inositol	24 milligrams
Biotin	2 micrograms
Vitamin B12	0.02 milligram

(Campbell, 1963)

Induced Disease for Rats:
All of the animals were maintained in controlled environments with a light-dark cycle of twelve hours, a relative humidity of fifty-five percent, & a temperature of 23±3 degrees Celsius. Prior to the onset of the investigation, the animals were acclimated by consuming water ad libitum & being fed a basal diet for one week.

Experimental diet:
The experimental diet was derived from the basal diet with the addition of powdered Solenostemon leaves in place of 7.5 percent corn starch.

Experimental Design and Animal Groups:
In the course of the experiment, thirty Sprague Dawley albino white male rats were utilized, with an average weight of 150 ± l0g. Seven days of a basal diet were used to acclimate mice. Following this, mice were distributed at random into five-percent equal groups of six mice each. Group 1, A group of typical rodents was given a basic diet and used as the negative control. In accordance with the methodology defined by **Drury and Wallington (1980),** a single intraperitoneal injection of potassium bromate at 125 milligrams per kilogram of body weight was administered to the other four groups in order to induce oxidative stress.

Under regular laboratory conditions, rats were confined in wire cages & fed a standard diet for a duration of one week. This was done as part of the adaptation period. With the use of feeding cups that were not scattered, a diet was provided in order to avoid any cases of food loss or contamination. The rats were provided with water through glass tubing that passed through the wire cage. One side of the cage was supported by an inverted bottle. Group 1, comprising healthy rats, was given a standard diet and acted as the control group. Each of the other four groups received a solitary intraperitoneal injection of potassium bromate. The rat classes consisted of the following:

Group 1 : six mice were fed basal diet (control negative).
Group 2: A group of six mice that did not receive any treatment were given a basic diet after receiving a single injection of KBrO3 (125 mg per kilogram body weight) into their abdominal cavity. (posit positive control)
Group 3: Six mice were administered a basal diet supplemented with five percent char plant (Solenostemon leaves) After administering a single intraperitoneal injection of 125 milligrams per kilogram of body weight of KBrO3.

Group 4: A basal diet comprising ten percent char plant (Solenostemon leaves) was administered to six rats subsequent to a singel intraperitoneal injection of KBrO3 (125 milligrams per kilogram of body weight).
Six rats were provided with a basal diet supplemented with fifteen percent char plant material. (Solenostemon leaves) following one intraperitoneal injection with KBrO3 (125 mg/kg B.Wt)

Biological evaluation:
Throughout the 28-day experiment duration, daily feed consumption and weekly body weight measurements were documented. The food efficiency ratio (F.E.R.), body weight gain, & organ weight were ascertained in accordance with the methodology described by **Chapman et al. in 1959.**

Blood sampling:
Following a 12-hour fasting period, blood samples were obtained at the conclusion of the investigation. Blood was collected via the retro-orbital method utilizing a micro capillary glass tube. The sample was then transferred to a dried out, sterile centrifuge tube & allowed to clot for a duration of thirty minutes in a water bath set at 37ºC at room temperature. After being centrifuged at a speed of 3000 revolutions per minute for ten minutes, a part of the serum was analyzed for glucose content in order to separate it from the blood. The remaining substance was cautiously suctioned and moved into sterile stoppile plastic tubes; thereafter, it was frozen at a temperature of -20ºC awaiting further examination. The organs, namely the liver, heart, kidney, & spleen, were extracted, rinsed with saline solution, weighed, & preserved in a ten percent formalin solution in accordance with the procedures outlined by **(Drury and Wallington ,1967).**

Biochemical analysis:
Determination of lipids fraction:
1- Total cholesterol measurement (TC):
The method for determining serum total cholesterol was as described by **Allain .(1974)**
2- Triglyceride determination (TG):
Triglycerides in the serum were measured utilizing the technique described by **Fossati and Prencipe.(1982)**
3- The measurement of HDL-c, or high-density lipoprotein cholesterol:
The procedure utilized to identify serum high density lipoprotein cholesterol was as described by **Lopez in 1977.**
4- Measurement of low-density lipoprotein cholesterol (LDL-c):
The serum low-density lipoprotein cholesterol was determined using the equation developed by **Castelli et al. in 1977.**
LDL-c (mg/dl) = Total cholesterol - [HDL-c + VLDL-c]
5- Very low-density lipoprotein cholesterol (VLDL-c) measurement:
The serum very low-density lipoprotein cholesterol was determined using the milligrams per deciliter equation **(Srivastava et al., 2002).**
VLDL-c (mg/dl) = Triglycerides /5
6- Determination of atherogenic index (AI):
Atherognic index was estimated as:
(AI) = VLDL + LDL cholesterol / HDL ratio according to the formula of **(Kikuchi-Hayakawa et al., 1998).**
Determination of kidney functions:
1- Determination of urea:
The method suggested by **Malhotra (2003)** was used to determine serum urea.
2- Determination of Creatinine:
The serum creatinine measurement was conducted using the approach described by **Bohmer.(1971)**
3- Determination of uric acid:
Uric acid concentration in the serum was determined using the technique outlined by **(Fossati and Prencipe, 1980).**
4.2.1.8.6. Determination of antioxidant enzymes:
1- Assay of superoxide dismutase (SOD) activity (U/L):
The method utilized to measure SOD was as described by **Sun et al.(1988) .**
2- Assay of glutathione peroxidase (GPX) activity (ng/ml):
Determination of GPX carried out according to the method of **(Zhao et al., 2001).**
3- Assay of catalase (CAT) activity (mmol/L):
The assay for catalase activity was conducted using the methodology described by **Diego (2011).**
Statistical Analysis: Calculations for statistical analyses were performed using one-way classification. The concepts of least significant difference (LSD) and analysis of variance (ANOVA) were defined by **Snedcor & Cochran in 1967.**

RESULTS AND DISCUSSION

This research aimed to determine the effectiveness of the char plant (*Solenostemon* leaves) in improving lipid profile, kidney function, and antioxidant enzymes in rats suffering from oxidative stress.
Biological results:
Lipid fraction of serum:

- **Total cholesterol (TC):**

The data in Table 5 show the total cholesterol in the serum of experimental rats. We observed an increase in TC during KBrO3 intoxication. It is evident that the control (-) group showed a decrease of 23.23% compared to the control (+) group, with a statistically significant distinction among them. The total cholesterol (TC) levels (measured in milligrams per deciliter) were

evaluated in all mice that were drunk with KBrO3 and fed with the studied plant diets (G3, G4, and G5) and decreased significantly, ranging from -4.04% to -23.23%, Compared to the control group (+). The maximum decrease in limit was observed in G5 (a fifteen percent char plant).

Triglycerides (TG):
Table 5 presents the TG values of the experimental mice. It was evident that the control (-) group exhibited a reduction of -15.74% Compared to the control group (+), representing a statistically significant distinction among the two groups. The serum triglyceride (TG) (mg/dL) levels of all experimental diets (G3, G4, and G5) decreased significantly, varying from -19.44% to -23.61% lower than those of the control group (+). In addition, G3 (five percent char plant) & G5 (15%) char plants exhibited a greater reduction in TG than the control group. G3 (five percent char plant) exhibited the most substantial reduction in serum triglyceride (TG) levels (mg/dL) compared to the other groups.

Very low-density lipoprotein cholesterol (VLDLc):
Table 5 presents the VLDLc concentrations in the serum of the experimental rats. The results indicated that KBrO3 intoxication significantly increased VLDLc in the serum, whereas nutritional intervention with experimental diets (G4, G3, and G5) lowered it by a range of -23.16% Compared to the control group (+) The group that achieved the greatest decrease in limit was G3 (five percent char plant), which differed significantly from the other groups.

Table (5): Effect of the char plant (*Solenostemon* leaves) on Total cholesterol (TC), Triglycerides (TG), & very low-density lipoprotein cholesterol (VLDLc) in rats suffering from oxidative stress.

Groups	TC (mg/dl) Mean ± SD		TG (mg/dl) Mean ± SD		VLDLc (mg/dl) Mean ± SD	
	(mg/dl)	% of Change	(mg/dl)	% of Change	(mg/dl)	% of Change
G1 (- ve)	76 f± 1.00	-23.23	60.67d± 1.04	-15.74	12.13d±0.208	-15.76
G2 (+ ve)	99a±0.3		72a± 1.5	------	14.4a± 0.3	------
G3 5% char plant	87d±2.00	-12.12	55f±1.5	-23.61	11f±0.3	-23.16
G4 10 % char plant	95b± 1.00	-4.04	64c± 0.5	-l8.22	12.8c± 0.1	-11.11
G5 15%char plant	76f± 0.5	-23.23	58e± 1.3	-19.44	11.6e± 0.26	-19.44
LSD	2.515		2.14			0.4281

*** All results are expressed as mean ± SD (standard deviation of the mean).**
*** Values in each column with different letters are significantly different (P< 0.05).**
*** One-way ANOVA test used**

High density lipoprotein cholesterol (HDLc):
Table 6 summarizes the serum HDLc levels of the rodents used in the experiment. It is evident that KBrO3 intoxication significantly decreased excellent cholesterol levels (from 49.5 to 35.4 mg/dL). Conversely, the aforementioned alteration was reversed by feeding experimental diets (G3, G4, and G5), with the G5 (15 percent) char plant containing the maximum increase limit, which differed significantly from the others.

Low density lipoprotein cholesterol (LDLc):
The data offered in Table 24 and Fig. 24 show the LDLc level of experimental rats. Due to $KBrO_3$ intoxication, the LDLc level was raised significantly (14.37 to 49.2 mg/dl). However, consumption of plant-based diets significantly reduced the level of LDL. The most effective therapy was G5 (fifteen percent char plant), which had a non-significantly different LDLc content than the control group.

Atherogenic index (Al):
The results of Table 6 demonstrate the Al ratio of the mice in the experiment. The poisoning of KBrO3 significantly increased the Al ratio (the Al of the control (-) group was -70.17% of the control (+) rats). In contrast, experimental diets (G3, G4, and G5) included nutritional intervention, resulting in significant reductions in Al levels. Notably, the G5 group (fifteen percent char plant) observed -66.83% less Al than the control (+) group. In addition, the Al value of G5 (15 percent char plant) wasn't significantly different from that of control (-) rats. These findings are consistent with those of **Bone and Mills (2013) and Marrelli et al. (2016),** who demonstrated that Solenostemon leaves reduced LDLc & TC cholesterol levels in the plasma. In obese rodents, treatment with various fractions of Solenostemon leaf extracts raised blood HDLc, as shown by **Coelho et al. (2008).** The same trend of change was found by **Gil *et al.* (2000)** They reported also that the levels of serum triglycerides, VLDLc, LDLc, & AI

were significantly ($p < 0.05$) reduced in hypercholesterolemic groups administered with 5% Solenostemon leaves compared to the positive control group.

Table (6): Effect of different levels of the char plant (*Solenostemon* leaves) on High density lipoprotein cholesterol (HDLc), Low density lipoprotein cholesterol (LDLc)and Atherogenic index (Al) in rats suffering from oxidative stress.

Groups	HDLc (mg/dl)		LDLc (mg/dl)		AI	
	(mg/dl)	% of Change	(mg/dl)	% of Change		% of Change
G1 (- ve)	49.5a±0.6	+39.83	27e±1.00	-67.47	0.537 g± 0.003	-70.17
G2 (+ ve)	35.4h± 0.3		14.37g± 0.603	-70.79	1.8a± 0.03	
G3 5% char plant	45.1cd±0.5	+27.4	49.2a±0.3		0.93e±0.07	-48.33
G4 10 % char plant	39.6f± 0.5	+ 11.86	30.9d±2.2	-37.2	1.397b± 0.006	-22.39
G5 15% char plant	47.6 b± 1.3	+34.46	42.6b± 0.6	-13.41	0.597g±0.055	-66.83
LSD	1.364		16.8g±2.06	-65.85	0.071	

Kidney function:

Serum creatinine:

Table 7 presents the serum creatinine levels of the rodents that participated in the experiment. We observed an increase in serum creatinine levels due to KBrO3 intoxication. It could be observed that the control (-) group showed -79.71% less than that obtained for the control (+) group, with significant variance among them. All mice in the experimental diets (G4, G3, and G5) demonstrated significant reductions in serum creatinine (milligrams per deciliter), varying from -69.91% to -80.77% in the control (+) group & with non-significant variance in the control (-) group. The lowest serum creatinine (mg/dl) recorded for G3 (5% char plant).

Urea:

The data shown in Table 7 demonstrate the impact of feeding the tested plant on serum urea (milligrams per deciliter). It could be observed that the control (-) group showed -54.55% less urea than that detected for the control (+) group, with significant variance among them. Experimental diets (G3, G4, and G5) presented significant reductions in serum urea (milligram/deciliter) ranging from -27.27% to -38.54% of the control (+) group, due to the fact that the greatest reduction was observed in G5 (15%) char plant.

Uric acid:

The results shown in Table 7 show the uric acid level in the serum of experimental rats. $KBrO_3$ intoxication raised considerably the serum uric acid, while due to plant diet intakes, the level decreased appreciably, especially in the case of G5 (5% char plant), which recorded a -61.33% decrease compared to the control (+) group with non-significant variance compared with G4 (10% char plant). The findings are consistent with **Yantih *et al. (2017).*** Rats injected with the extract of the char plant exhibited a notable elevation in total protein content in comparison to mice injected with ISO, which can be attributed to the antioxidant properties of the extract.

Table (7): Effect of different levels of the char plant (*Solenostemon* leaves) on Serum creatinine, Serum urea, & Uric acid in rats suffering from oxidative stress.

Groups	Creatinine (mg/dl)		Urea (mg/dl)		Uric acid (mg/dl)	
	(mg/dl)	% of Change	(mg/dl)	% of Change		% of Change
G1 (- ve)	0.71b± 0.07	-79.71	20g±2.00	-54.55	3d±0.1	-60
G2 (+ ve)	3.5a±0.33		44a±3.00		7.5a±0.2	------
G3 5% char plant	0.673b±0.312	-80.77	32de±2.00	-27.27	3.2cd±0.1	-57.33
G4 10 % char plant	1.053b± 0.07	-69.91	36bcd± 1.00	-18.18	3.3 bcd±0.3	-56

G5 15% char plant	**0.943b± 0.129**	**-73.06**	**27f± 2.00**	**-38.64**	**2.9d± 0.3**	**-61.33**
LSD	**0.298**		**3.478**		**0.388**	

Antioxidants enzymes:

Serum catalase (CAT) activity (mmol/L):

The impact of experimental diets on the levels of CAT (mmol per liter) in the blood serum of mice intoxicated with KBrO3 is shown in Table 8. It could be observed that the control (-) group showed +54.2% over that obtained for the control (+) group, with a significant distinction between them. The serum concentrations of CAT (mmol/L) in all mice from the tested plant increased significantly, ranging from +23.66% to +46.56% of the control group. In comparison to all other diets, G5 (15 percent char plant) exhibited a significant rise in CAT serum levels (mmol/L), although the distinction wasn't statistically significant when compared to the control group.

Serum superoxide dismutase (SOD) activity (mmol/L):

The results in Table 8 show the SOD activity in the serum of experimental mice. It is obvious that, due to $KBrO_3$ intoxication, serum superoxide dismutase activity has reduced from 60.42 to 46.2 mmol/L. Nevertheless, feeding on experimental diets (G3, G4, and G5) significantly increased the serum superoxide dismutase activity; in G5 (15% char plant), there was no significant difference with G4 (10% char plant). Group 5 (15% char plant) revealed a higher increase in serum superoxide dismutase activity compared with the control (+) group.

Glutathione peroxidase (GPX) activity (ng/ml):

The results in Table 8 illustrate the GPX activity in the serum of experimental rats. It is clear that due to KBrO3 intoxication, the GPX activity reduced remarkably from 0.75 to 0.4 ng/ml, with a significant difference between them. Experimental diets (G3, G4, and G5) exhibited significant increases in serum GPX (ng/ml) levels, ranging from +65% to +70.25% in the control (+) group, while no significant variations were observed in the G5 (15 percent) char plant or control (-) groups. These results are consistent with **Edelman and Colt (2016).** Research has shown that *Solenostemon leaves* are a highly beneficial source of the mineral manganese, which is a trace material. Manganese is a vital cofactor in multiple enzymes that have a critical function in the creation of energy and the protection against oxidative damage. Manganese is necessary for the crucial oxidative enzyme superoxide dismutase, which counteracts free radicals generated in the mitochondria. (the cellular engines responsible for energy production).

Table (8): Effect of different levels of the char plant (Solenostemon leaves) on Catalase (CAT) activity, Superoxide dismutase (SOD), and GPX activity in rats suffering from oxidative stress.

Groups	CAT (mmol/L)		SOD (mmol/L)		GPX (ng/mt)	
	(mmol/L)	% of Change	(mmol/L)	% of Change	ng/mt)	% of Change
G1 (- ve)	**0.202a±0.002**	**+54.2**	**60.42a± 1.06**	**+87.5**	**0.75a±.02**	**+87.5**
G2 (+ ve)	**0.131c± 0.016**	**------**	**46.2d± 1.23**	**------**	**0.4e±0.004**	
G3 5% char plant	**0.162abc±0.026**	**+23.66**	**56.2b±2.04**	**+65**	**0.66b±0.041**	**+65**
G4 10 % char plant	**0.141c± 0.009**	**+17.63**	**51.34c± 0.95**	**+43**	**0.572c±0.027**	**+43**
G5 15% char plant	**0.192 ab± 0.011**	**+46.56**	**58.34ab± 1.32**	**+70.25**	**0.681b± 0.052**	**+70.25**
LSD	**0.0286**		**2.171**		**0.0506**	

CONCLUSION

Char plant leaves (*solenostemon leaves*) possess a significant antioxidant capacity. Degenerative illnesses & oxidative stress caused by an excess of free radicals may thus be prevented with its assistance. The leaf demonstrated a greater propensity for utilization as a medicinal plant rather than for nutritional purposes.

RECOMMENDATIONS

It is suggested to use char plant leaves powder (*Solenostemon*) to improve biological functions (lipid profile - kidney function). different levels of char plant leaves powder (*Solenostemon)* may be suggested to improving Antioxidants enzymes.

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