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The Application of Dietary Wheat/Barley Alternative with Addition Cress Seeds Powder to Albino Rats

Nasreen Mohialddin Abdulrahman[1], Nasrin Hasan Aziz[2], Adel Jabbar Hussein[3], Zna Mohemmed[4], Iman Mahmmud[4], Sonya Salih[4], Hevar Aras Hama Salih[2,] Hemin N. Mohammed[2]

[1]College of veterinary medicine, University of Sulaimani, Kurdistan Region-Iraq
[2]College of Agricultural sciences/ University of Sulaimani, Kurdistan Region-Iraq
[3]College of Veterinary Medicine, University of Basrah /Basrah, Iraq
[4]Department of Biology, College of Education, University of Sulaimani, Kurdistan Region-Iraq

Abstract: the objective of this study was to change the normal diet of adult rats for nearly 21 days, the blood sample taken for comparison of changes in some blood parameters. The rats were kept in the metabolic cages separately and their body weight, consumption of food and water, urine volume, the levels of serum glucose, insulin and C-peptide quantities in all animals are measured and then these quantities are compared. Nosignificant differences observed in RBC 10^{12}/L and MCHC g/dL. The high level of carbohydrates sources in rat diets in term of wheat and barley increased significantly each of HGB g/dL and HCT percent. The liver function tests studied were differ within the different groups as the control was higher significantly in S. Globulin. The ALT was higher significantly in each of control, 4th and 5th groups. AST was higher also in 4th and 5th groups. The CRP was higher in 5th group. No significant differences observed in each of Total Protein and Albumin.

Keywords: Dietary Wheat/Barley Alternative, Cress Seeds Powder, Albino Rats

INTRODUCTION

Diets induce multiple metabolic processes and modify the metabolism homeostasis of the organism (Manore et al., 2017). Therefore, unhealthy dietary habits such as Western diet have been one of the most important drivers of glucose metabolism disorder that leads to diabetes finally (Rico-Campa et al., 2019).

In India, Europe, and the United States, garden cress (Lepidium sativum L.), a member of the Cruciferae family, is a common crop. Since the time of the Vedic civilization, it has been a significant medicinal herb. Its seed, oil, and powder all include sizable amounts of protein, fat, minerals, fibre, and phytochemicals that are added to a variety of functional drinks and dishes.A number of clinical trials have been conducted on rats that also support the efficacy of garden cress seeds. The seed of garden cress was used in the fortification of different food items but due to the lack of their physicochemical properties and medicinal value, the exploration of the potential of garden cress seed was limited(Singh and Paswan, 2017). *Lepidium sativum* or garden cress, is a well-known medicinal herb belonging to a plant family called Brassicaceae. *L. sativum*seeds possess numerous benefits that make it a superb medicinal herb. *L. sativum*has been used as a valuable medicinal plant for hundreds of years. It is commonly used in treating various diseases, including abdominal problems like diarrhea and dysentery. *L. sativum*has great beneficial effects as an anti-rheumatic, anti-flatulent, febrifuge, diuretic, and anti-hiccup medicine. *L. sativum*is also used in many countries across the globe for managing disorders like bronchitis and asthma, as well as diabetes (El-Emary, 2021).

Cress seeds are rich source of proteins, dietary fiber, minerals and essential amino acids. Cress seeds contain phenoliccompounds which might be responsible for its strong antioxidant capacity. Toxicology studies of Cress seeds revealedthat Cress seeds can be considered as non-toxic and safe. Cress seeds shows many medicinal properties such as antidiabetic, hypocholesterolemic, antihypertensive**,** antidiarrheal, antispasmodic and laxative activities. It also has fracture healing hepatoprotective, diuretic, nephrocurative, nephroprtective, galactogogue, antinflammatory, antipyretic and analgesic potential. Health drink and food products incorporated with Cress seeds or its fractions were sensorily acceptable. Cress seeds can be used as a promising multipurpose medicinal source whereas further clinical trial is required to prove its efficacy (Doke and Guha 2014).

The content of biologically active compounds, as well as the antioxidant capacity of *I. hederacea*and *L. sativum*have been investigated in this study. their findings indicate that seeds of both plants are a good source of amino acids, minerals, fatty acids and have the ability to act *in vitro* as antioxidants. This may be due to their high content of phenolic compounds. These plants may warrant further investigation for their potential preventive effects towards chronic diseases and should be further investigated as interesting ingredients for new functional food formulations (Zia-Ul-Haq et al., 2012).

The data of Mortreux et al., (2019)highlight MOB-PROK2 as a new actor in the relationship between olfaction, feeding behavior, and energy homeostasis. Although the specific deficiency of Prok2 in the MOB has only a moderate effect on the control of the energy balance, our data should be placed in a physiological context and compared with those showing a role of PROK2 in the hypothalamus. This system of regulating food intake, which is present in two key brain areas of energy balance control, works in synergy and in a complementary way in a physiological situation.

Theresults of Datta et al., (2011) clearly showed that the Cress seeds under the conditions tested,did not induce acute or subchronic toxic effects in Wistar rats. Cress seeds was well tolerated and did not inducetoxic effects even at 10% dietary level as evidenced by absence of any ill effects on growth, body weight gain,organ weight, histology, hematology or clinical enzymes in Wistar rats. The study of El-Emary (2021) focused on the treatment of diabeticWistar rats by administering an aqueous extract of Cress seeds.The study's findings reveal that Cress seeds is one of the medicinalplants that has the potential to cure diabetes andmanage disorders of bodily functions.

The objectives of the study to identify the benefits of adding Cress seeds as feed supplements in rats' diet with different ingredients as an alternative between wheat and barley.

Material and methods

This study was approved by the department of Biology/ College of Education and college of veterinary medicine according to university of Sulaimani guidelines. The animals (albino rats) were housed at the animal house of Biology department, kept in cages and were fed standard food.

In this study ten female adult's rats were used divided into five groups, each group with two rats. Their weighted between (150-200g). The rats were left for one week to become acclimatized at 22-25 C^0 with and 60–65% humidity, fed with standard food with no treatment, retired with rodent chow and water ad libitum. The animals had free access to food; water was given through drinking bottles. They were kept in cages filled with aspen shavings which was changed once to twice a week. The treatment started after one week for twenty-one days, first group fed a standard diet with wheat, second group replaced all wheat with barley, third group fed an equal amount of wheat and barley, fourth and fifth group study the effect of adding 5% Cress seeds with either wheat/ barley with the standard ratio as shown in table (1).

Table-1: Diet composition of different groups used in this experiment according to NRC, 1995.

Items	Control group	2nd group Complete replacement Wheat vis Barely	3rd group Partial replacement Wheat vis Barely	4th group 5% Cress seeds	5th group5% Cress seeds
Corn	25	25	25	24	24
Protein	25	25	25	24	24
Wheat	25	0	12.5	24	0
Barley	0	25	12.5	0	24
Oil	10	10	10	9	9
Milk	10	10	10	9	9
Salt	5	5	5	5	5
Cress seed	0	0	0	5	5
Total	100	100	100	100	100

After rearing the rats for nearly twenty-one days, each animal treated alone to get the blood samples. put each rat in a box contaminated with chloroform for about three minutes until they fully passed to make a V-shaped cut through their skin, after the dissection of the rat a blood sample taken from their caudal vein.

Blood samples obtained from the rats, divided into two sets of Eppendorf tubes. The first set contained sodium heparin (20 U/L), as an anticoagulant, for analyzing hematological parameters including white blood cells (WBC′s) count, red blood cells (RBC′s) count, hemoglobin (Hb) concentration, PCV % Platelets count and hematological indices (MCV, MCH, MCHC). The second set was left with no anticoagulant in order to clot at 4°C and centrifuged at 5000 × g for 20 min at room temperature to obtain serum for measuring the different biochemical parameters.

Serum biochemical analyses including glucose, total protein, total cholesterol, high-density lipoprotein cholesterol (HDL), low-density lipoprotein cholesterol (LDL), very low-density lipoprotein (VLDL), triglycerides, aspartate aminotransferase (AST), and alanine aminotransferase (ALT) were determined using an automatic biochemical analyzer using commercial kits from Spin react, S.A. (Gerona, Spain).

SAS (2001) were used as Statistical program analysis of complete random design (CRD) and correlation to the study effect transactions in the traits and compared the differences between the averages of columns by using polynomial test Duncan (Duncan, 1955).

Results and discussion

No significant differences observed in RBC 10^{12}/L and MCHC g/dL. The high level of carbohydrates sources in rat diets in term of wheat and barley increased significantly each of HGB g/dL and HCT percent. MCH pg was higher significantly in each control (1st group) and 2nd group. The adding of cress seeds powder did not affect the MCV fL in which the 1st, 2nd and 3rd group were higher significantly. The PLT 10^9/L was higher significantly in the control group. MPV fL was higher significantly in all groups as compared to the 2nd group as seen in (table 2).

(Table 2): The effect of application of dietary Wheat/ Barley alternative with addition cress seeds powder to control diabetes in some blood counts parameters (CBC) in rat

Treatment	RBC 10^{12}/L	HGB g/dL	MCH pg	MCHC g/dL	MCV fL	HCT %	PLT 10^9/L	MPV fL
1st Group	6.66 a	12.8 bc	19.2 a	33.2 a	57.8 ab	38.5 c	1289 a	6.9 ab
2nd Group	7.56 a	14.8 a	19.6 a	32.4 a	60.4 a	45.7 a	897 c	6.4 b
3rd Group	7.84 a	14.6 a	18.7 b	32.2 a	58 ab	45.5 a	761 d	7 ab
4th Group	7.78 a	13.8 b	17.8 c	33.1 a	53.8 c	41.8 b	1087 b	6.7 ab
5th Group	7.16 a	13.2 b	18.4 b	32.7 a	56.5 b	40.5 b	659 e	7.5 a

Group 1 (control); 2nd group Complete Replacement Wheat Vis Barely; 3rd group Partial Replacement Wheat Vis Barely; 4th group 5% Cress seeds; 5th group5% Cress seeds

Table (3) show that the 5th Group was higher significantly in WBC count, Lymphocytes and Monocytes as compared to other groups, while the control group was higher in Granulocytes count.

(Table-3): The effect of application of dietary Wheat/ Barley alternative with addition cress seeds powder to control diabetes in some white blood counts parameters in rat

Treatments	WBC 10^9/L	Lymphocytes 10^9/L	Monocytes 10^9/L	Granulocytes 10^9/L
1st Group	12.1 b	8.8 b	1.3 a	2:00 a
2nd Group	8.9 c	7.6 b	0.4 b	0.9 c
3rd Group	9.5 c	8.2 b	0.5 b	0.8 c
4th Group	10.6 bc	8.9 b	0.9 b	0.8 c

5th Group	19.1 a	16.1 a	1.5 a	1.5 b

Group 1 (control); 2nd group Complete Replacement Wheat Vis Barely; 3rd group Partial Replacement Wheat Vis Barely; 4th group 5% Cress seeds; 5th group5% Cress seeds.

The liver function tests studied were differ within the different groups as the control was higher significantly in S. Globulin. The ALT was higher significantly in each of control, 4th and 5th groups. AST was higher also in 4th and 5th groups. The CRP was higher in 5th group. No significant differences observed in each of Total Protein and Albumin as seen in (table 4).

(Table -4): The effect of application of dietary Wheat/ Barley alternative with addition cress seeds powder to control diabetes in some liver function tests in rat

Treatments	S. Globulin g/dL	ALT IU/L	AST IU/L	Total Protein g/dL	S. Albumin g/dL	CRP
1st Group	4.08 a	44 a	116 b	7.45 a	3.37 b	0.03 b
2nd Group	2.45 b	25 b	61 c	7.48 a	4.56 a	0.09 b
3rd Group	2.72 b	28 b	117 b	7.42 a	4.7 a	0.24 b
4th Group	2.99 b	45 a	132 a	7.1 a	4.11 a	0.25 b
5th Group	2.45 b	41 a	139 a	7.2 a	4.27 a	1.26 a

Group 1 (control); 2nd group Complete Replacement Wheat Vis Barely; 3rd group Partial Replacement Wheat Vis Barely; 4th group 5% Cress seeds; 5th group5% Cress seeds; CRP C-Reactive Protein; ALT (Alanine aminotransferase); AST (Aspartate aminotransferase).

The liver is a crucial part of the body that play a fundamental role in different physiological processesand functions including secretion, metabolism, andstorage. Numerous studies proved its important rolein the detoxification and excretion of endogenous wastemetabolites and exogenous toxic compounds from the body.

The liver is also involved in various biochemical processesof nutrient and energy supply, growth, etc. Additionally,it helps in carbohydrate and fat metabolism, bilesecretion, and vitamin storage. However, biologicalfactors, genetic factors, environmental factors, autoimmunediseases, toxic compounds, and chemicals result in damageof the cell, structure, tissues, and functioning of the liverand cause hepatic diseases. Modern drugs can also causean adverse effect on liver as they possess numerous sideeffects. Thus, there is a need to identify the alternativetreatment of hepatic diseases to discover more effective andless toxic natural agents and these may be the reasons of the results in the table (4).

(Table 5): The effect of application of dietary Wheat/ Barley alternative with addition cress seeds powder to control diabetes in lipid profile and Glucose tests in rat

Treatments	Total Cholesterol mg/dL	Triglyceride mg/dL	LDL mg/dL	HDL mg/dL	Glucose mg/dL
1st Group	76	131	18	52	411
2nd Group	54	67	9	39	319
3rd Group	65	31	14	51	153
4th Group	73	66	14	54	150
5th Group	77	52	14	54	170

Group 1 (control); 2nd group Complete Replacement Wheat Vis Barely; 3rd group Partial Replacement Wheat Vis Barely; 4th group 5% Cress seeds; 5th group5% Cress seeds

One of the biggest challenges for health care providers today is addressing the continued needs and demands of individuals with chronic illnesses like diabetes. The importance of regular follow-up of diabetic patients with the health care provider is of great significance in averting any long-term complications. Studies have reported that strict metabolic control can delay or prevent the progression of complications associated with diabetes. The needs of diabetic patients are not only limited to adequate glycemic control but also correspond with preventing complications; disability limitation and rehabilitation.

The nephropathy diabetic rats had higher ($P \leq 0.05$) blood glucose level than those in normal control during the experimental period of Nasef et al., (2021). Wei et al., (2003) who found that STZ had a high affinity for binding to the glucose receptors present on the pancreatic β-cells, its ingestion relish the cytotoxic effect upon these cells and lead to dysfunction or cell death. This subsequently leads to alteration of insulin levels and blood glucose concentrations. However, the blood glucose level of nephropathy diabetic rats fed on GCP diets was significantly ($P \leq 0.05$) decreased by increasing GCP levels. The highest reduction in blood glucose level was found in nephropathy diabetic rats fed on 10% of GCP. These results confirmed the results of Qusti et al., (2016) who showed that treating the diabetic rats with *L. sativum* and cinnamon methanol extracts, significantly decreased the mean values of serum fasting blood sugar compared with the positive control. This result is consistence withAbdelwahab et al., (2014) who showed that using the aqueous *L. sativum* extract that can significantly reduce the blood glucose levels after a single or repeated administration.

The study of (Nasef et al., 2021) showed that the GCP *Lepidium sativum* efficiently regulate blood glucose and improves disruption of kidney functions abnormalities associated with diabetes in STZ and gentamicin induced nephropathy diabetic rats possibly by virtue of various essential antioxidant, antidiabetic compounds. GC can thus contribute towards prevention and management of diabetes mellitus and nephropathy and it associated complications.

Data of Nasef et al., (2021) indicate the effect of GCP on serum levels of Liver functions (AST, ALT and ALP enzymes) of nephropathy diabetic rats. The obtained results showed the gentamicin and STZ can cause alterations in the level of hepatic biochemical markers throw increasing the serum levels of aspartate amino transaminase (AST), alanine aminotransferase (ALT), and alkaline phosphatase (ALP) compare with normal rats. Those data were in agreement with Ademiluyi et al. (2013) who demonstrated that GM administration significantly damaged liver cells as manifested by a large increase in ALT and AST activities and total bilirubin level.and with the present study. Moreover, it caused a marked decrease in total protein concentration indicating a failure in liver synthetic capacity caused by GM administration. A significant decrease ($P \leq 0.05$) in the elevated level of liver enzymes was noticed in treated groups when compared with positive control rats. The best values of liver enzymes were recorded to 10% of GCP compare to (+) control rats. These data are in agreement with those of Pandit et al., (2012) and Zamzami et al., (2019) who confirmed that concurrent treatment of rabbits injured with CCl_4 for 5 and 10 weeks with *L. sativum* seeds led to significantly repaired their liver enzymes such as elevation of total protein and albumin improved with decrease level of globulin. Dixit et al., (2020) conclude that *Lepidium sativum* is a rich source of calcium and phosphorus that accelerates bone healing and can be used as an alternative to present supplements prescribed.

Generally, GC is consumed as cooking material and with salad. In recent years, efforts are made to develop human diets in such a way that it acts as medicinal foods in order to exploit several health benefits and to prevent increased diversity of diseases. The content of biologically active compounds, as well as the antioxidant capacity of *L. sativum* has been investigated by several researchers and their findings indicated that seeds of garden cress plants are good source of amino acids, minerals, fatty acids and have the ability to act as *in vivo* as well as *in vitro* antioxidants due to their high content of phenolic compounds. The functional health benefits of GCS may be exploited by incorporating it in several food formulations and health drink preparations. Therefore, garden cress plant, seed as well as oil present us with wide scope for further investigations for their potential preventive effects toward chronic diseases and also as interesting ingredients for new functional food formulations (Singh and Paswan, 2017).

The study of Abdel-Baky (2019) concluded that, sodium nitrite had adverse effects on the kidney. Garden cress seeds aqueous extract supplementation showed a remarkable amelioration of the nephrotoxicity induced by sodium nitrite in male rats. So, it is recommended that the use of sodium nitrite must be limited and using of garden cress seeds extract to alleviate the toxic effects of sodium nitrite.

The results of (Shawle et al., 2016) show that inclusion of garden cress up to 2.25 % result in no adverse effect on the health of broilers. However, lower level (0.75 %) garden cress inclusion tend to improve body weight, feed efficiency, hematological and blood biochemical indices. Therefore, we conclude that garden cress can be included in broilers diet as feed additive at a level of 0.75 % of the total ration.The findings obtained in the study of Alkahtani et al., (2020) indicate that GC polysaccharides has antibacterial and has a possible source of natural antioxidant and also has cytotoxic effect on different carcinoma cell lines.

L. sativum is considered a valuable source of nutrition with significant therapeutic properties. In the last few years, several researchers from different regions have investigated the nutritional profiling of the leaves, seed, and seed oil of *L. sativum*, the nutritional profiling showed that the leaves, seeds, and seed oil of *L. sativum*possess appropriate nutritional content which can help in combating anemia, malnutrition, and several micronutrient deficienciesand this may explain most of the results of the present study. it can be concluded that *L. sativum* is a rich source of nutritional components along with bioactive compounds and could be used as a functional food.

On the basis of the study of Al-khazraji (2012)concluded that *L. sativum* seeds exert a significant hypoglycaemic and hypolipidemic effects, since both diabetesand hyperlipidemia are considered to be major risk factors for the premature atherosclerosis and essentially all cholesterol in atheroclorotic plaques is derived from that of circulating cholesterol the actual mechanism for the hypoglycaemic and hypolipidemic effects of *L. sativum*is not clear, and further biochemical and pharmacological investigations needed to isolate and identify the active ingredient(s) in the composite extract.

Inthe clinical study of PARANJAPE and MEHTA (2006) on *L. sativum*, all patients were found to show the trend towards decrease in severity of symptoms of asthma and improvement in lung function parameters. Thus, considering the efficacy and convenience of oral administration and easy availability, this drug appears to have good future in treatment of asthma. Moreover, none of the patients showed any adverse effect in dose used and no change was observed in general physical parameters and hematological pro-file of the patients suggesting good tolerability of this drug.More effective and economical methods to the modification and preparation of polysaccharides remain major challenges and therefore an important field of research is yet to come.

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