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Biochemical and nutritional impact of celery and turnip leaves on induced obese by high fat diet (HFD)

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Abstract: The high fiber diet is reported to have substantial health benefits such as anti-obesity. So, this study evaluated the effect of celery and turnip leaves on high fat diet (HFD) induced-obese rats. Sprague-Dawley male rats aged 4 weeks old divided 6 groups: *G1*, fed on basal diet and *G2* fed on HFD during the nutritional experimental period, *G3* fed on HFD with oral administrated water extract of celery, *G4* fed on HFD with oral administrated water extract of turnip leaves, G5 and *G6* fed on HFD containing fresh blanch of celery and turnip leaves (as 5% fiber content), respectively for 7 weeks. Finally, at the end of experimental period the blood samples were collected. Rats were weighted, killed and organs were removed. Histopathological and adipose tissue tests were evaluated. Results: Generally, the results showed that the treated rats by celery and turnip leaves had significant decrease in body weight gain and feed intake compared to positive control. Also, celery and turnip leaves had significant decrease in TG, TC, LDL-C and VLDL-C.Similarly, celery and turnip leaves caused reductions in the atherogenic index and coronary risk index (AI and CRI). The liver and kidney functions were decreased when rats fed on HFD with celery and turnip leaves compared to positive control. And rats fed on celery and turnip leaves diets had significant increase in fasting insulin concentration compared to positive control. Concerning histopathological findings; the HFD group had a high changes in liver and kidney. The rats fed on HFD with water extract of both celery and turnip leaves had normal aorta, while some changes in liver and kidney were detected. The rats fed on HFD with 5% as fiber from turnip leaves had a few changes in liver and kidney. The rats feeding on HFD with fresh blanch celery had the lowest weight of total adipose tissue mass and no. of pad cell. Conclusion: using vegetables caused decrease in serum lipid profile, loss body weight, reductions in AI, CRIand prevent the accumulation of white adipose tissue (WAT) in rats. Also, it is a good sources of fiber and bioactive compounds which using as functional compounds.

Keywords: Obesity, Celery, Turnip Leaves, Feeding, Adipose Tissue Mass, Blood Lipid Profile, Insulin Concentration, Histopathology

1. Introduction

The inviolable assumption that obesity is simply a thermodynamic problem of calories in/calories out is being dissembled by the science linking environmental toxins to obesity and diabetes. Exposure to environmental toxins in the absence of increased caloric intake induces weight gain and insulin resistance. Stated simply, toxins are an invisible,unappreciated cause of obesity and diabetes.Clearly, our sedentary, high-stress lifestyle and our high glycemic, trans fat– and saturated fat–rich, low-fiber, phytonutrient-poor diet contributes to the epidemic of diabetes and obesity.But the increasing burden of environmental toxins, including persistent organic pollutants and heavy metals, can no longer be ignored as a key etiologic factor in the epidemic of obesity and diabetes, or what should be called “diabesity,” the continuum of metabolic dysfunction mild insulin resistance to end-stage diabetes [1].

Obesity is characterized by increased body fat mass, arising from the prolonged imbalance between energy intake and energy expenditure which results from both increased fat cell number and increased fat cell size, and may lead to a variety of diseases, such as cardiovascular disease, non-alcoholic fatty liver disease and hormonal imbalances in women, leading to sterility [2].

Young adults tend to be affected largely by over nutrition. Males were aged 10 – 19 years (5%) are under weight and the same proportion is overweight. Similar proportions of overweight were observed in girls; six percent were overweight. Some (15 % of males and 19 % of females) of

youthare at risk of becoming obese. In adults there was a gender difference in overweight and obesity levels. Men (34 percent) had higher levels of overweight compared to females (28 %). On the contrary obesity was more prevalent amongst women compared to men, 40 % of women were obese compared to 18 % of men. Both men and women who resided in urban areas were more likely to be obese compared to their rural counterparts. It is evident that over nutrition is a challenge for youth and adults in Egypt [3].

Dietary fibers find an important role in the normal functioning of the gut, as well as in maintaining the cholesterol levels in humans. The importance of dietary fibers have not been realized by the authorities and so has not been separately classified so far, but has constantly been associated in short term and acute studies with serum cholesterol reduction and reduced postprandial glucose and insulin responses. Ironically, it is the insoluble cereal fiber, which is associated with protection from Coronary heart disease (CHD) and diabetes in cohort studies despite a relative absence of demonstrated metabolic effects. Soluble fibers appear to have their effect by reducing the rate of absorption from the small intestine. Similar metabolic effects have been seen with slowing the rate of absorption by other means such as sipping versus bolus ingestion of glucose, increasing meal frequency, or reducing the rate of glucose absorption by the use of low glycemic index foods. However, in this last case, benefits have also been noted in cohort studies in terms of diabetes and CHD risk reduction. Furthermore benefits also appear in relation to the incidence of certain cancers. Soluble fibers therefore have good reasons to have a range of metabolic health benefits [4]. And, [5] concluded that, a high level of fiber intake has health-protective effects and disease-reversal benefits. Persons who consume generous amounts of dietary fiber, compared to those who have minimal fiber intake, are at lower risk for developing CHD, stroke, hypertension, diabetes, obesity, and certain gastrointestinal diseases. Increasing the intake of highfiber foods or fiber supplements improves serum lipoprotein values, lowers blood pressure, improves blood glucose control for diabetic individuals, aids weight loss, and improves regularity.However, [6] suggested that differences in response to dietary fiber intake in this animal model because high-fat diets incorporating dietary fibers appeared to attenuate weight gain, enhance insulin sensitivity, and modulate leptin and glucagon-like peptide 1 (GLP-1) secretion and gastric ghrelin gene expression.

Leafy green vegetables and fruits have generated interest worldwide as they exhibit multiple benefits for health of human beings. Carotenoids such as b-carotene, a-carotene, c-carotene and b-cryptoxanthin, present in agricultural and horticultural produce, have provitamin-A activity and are potent antioxidants and modulate the pathogenesis of several chronic degenerative diseases [7]. *Brassicaceous* plants are consumed increasingly for possible health benefits, for example, glucosinolate-derived effects on degenerative diseases such as cancer, cardiovascular and neurodegenerative diseases [8]. Previous studies reporting phytonutrient concentrations in Brassica crops, have focused on certain constituents in a particular crop, like glucosinolates in broccoli [9] or carotenoids in kale or broccoli [10]. Very little is known about other critically important human bioactive vitamins and carotenoids (phytomicronutrients) in collard, mustard and turnip leafy greens or the impact leaf maturity has on phytonutrient concentrations [11].

Celery (*Apium graveolens*) is an excellent source of vitamin C, folate, B1, B2, B6, A,dietary fiber, K, Ca, Mg, P and Fe [12]. Also, it is widely used worldwide in human nutrition. The green parts of the plant are widely used in soups and salads and have been found to contain biologically active compounds [13 and 14]. Moreover, it has been used in traditional medicine primarily as a diuretic and treat bronchitis, asthma,liver and spleen diseases [15].

The present study aimed to examine the protective effect of feeding on celery and turnip leaves and their water extracts against induced obesity, blood contents and fat tissue in adult rats.

2. Materials and Methods

2.1. Plant and Water Extract Preparation

Blanching plant: Celery (*Apium graveolens*) andturnip (*Brassica rapa* L.) greens leavesbunches were obtained from a local market in Giza, Egypt.Celery and turnip leaves (200g) were added to boiling tap water in a covered stainless-steel pot (1:3 food/water) and blanched for 60 seconds. Then, samples were drained off for 5 minutes.

Water extract preparation: Both celery and turnip leaves (200g) were added to boiling tap water in a stainless-steel pot (1:3) and boiling to concentrated to about (1:2). Then, cooling to room temperature and pass through cotton cloths to remove a fiber.

2.2. Chemicals

Folin-Ciocalteu phenol reagent (2N), quercetindihydrate (2-(3,4- dihydroxyphenyl), and gallic acid were purchased from Sigma–Aldrich (St. Louis, MO, USA).Cinnamic acid, protocatchein, catechein, syringic acid, chlorogenic acid, benzoic acid, ferullic acid, ellagic, catecho, caffien, coumarin, vanillic, salcyic, chrysin, gallic acid and caffeic acids as compounds standards were purchased from Sigma–Aldrich (St. Louis, MO, USA).Narenginin, rutin, kaempferol, quercetin, rosmarinic acid, quercetrin, hispertren and letulin as compounds standards were purchased from Sigma–Aldrich (St. Louis, MO, USA). The kits were obtained from Randox Laboratories Ltd., Diamond Road, Crumlin,Co., Antrim, United Kingdom, BT294QY..The HPLC solvents were purchased from Fisher Scientific (Fair Lawn, NJ, USA).

2.3. Chemical Composition

Moisture, protein, total fat, crude fiber and ash contents were determined according to [16]. Nitrogen free extract

(NFE) was calculated by difference. Calorific value of the celery and turnip leaves were calculated using the appropriate factor as described by Lawrence [17].Total phenols in celery and turnip leaves were determined by folin-ciocalteau's reagent as described by [18]. The total flavonoid content was determined by aluminum chloride method according to [19]. Chlorophyll-A, chlorophyll-B and carotenoids were extracted and calculated according to [20]. Antioxidant activity was determined by the 1,1-diphenyl-2-picryl-hydrazyl (DPPH) method according to [21].

2.4. Determination of Fiber Fraction

Dietary fiber was determined according to [22].

2.5. Biological Study

2.5.1. Animals

Fortyeightadult male Sprague-Dawley rats aged 4 weeks old (110±3 g) were purchased from theLaboratory Animal Department, Research Institute of Ophthalmology, Giza, Egypt. The animals were housed in plastic cages and fed on basal diet [23], and provided water *ad libitum* for one week as an adaptation period. The animal room temperature was maintained at 21˚C ± 2˚C with timed lighting 12h and relative air humidity of 40% to 60%. While, animals were housed in plastic cages and fed on high fat diet according to [6] and the fat percentage was modified to 25% only (table 1).

Table (1). *Diet composition during treatment the rats obese by celery and turnip leaves*

Ingredients	G1	G2*	G3	G4	G5	G6
Corn starch	56.3	28.91	30.975	30.975	25.975	25.975
Casein (protein ≥85%)	14	22.8	20.52	20.52	20.52	20.52
Sugar	10	17.5	17.5	17.5	17.5	17.5
Corn oil	10	5	5	5	5	5
Hydrogenated palme oil	--	20	20	20	20	20
Salt mixture	3.5	3.5	3.5	3.5	3.5	3.5
Vitamin mixture	1	1	1	1	1	1
Sodium bicarbonate	--	1.05	0.945	0.945	0.945	0.945
Potassium citrate	--	0.04	0.36	0.36	0.36	0.36
Choline chloride	0.2	0.2	0.2	0.2	0.2	0.2
Cellules	5	--	--	--	--	--
Fresh blanch celery**	--	--	--	--	416.67	--
Water celery extract†	--	--	2ml	--	--	--
Fresh blanch turnip **	--	--	--	--	--	387.60
Water turnip extract†	--	--	--	2ml	--	--

* The rats fed on HFD during allperiod of experimental (14 weeks) ** Equal 5% (as fiber) † 2ml / day/ rat.

2.5.2. Experimental Design

After the adaptation period (a week) the rats were randomly divided into 6 groups as shown as in fig (1). The control groups (-/+) were contained 12 rats and other groups contained 6 rats.The first stage was aim to induce obesity, rats in groups from G2 to G6 were fed on high fat diet (HFD) for 7weeks. Second stage, rats in groups (G3 – G4) were treatment by water extract of both celery and turnip leaves and (G5 and G6)were treatment by blanched both celery and turnip leaves for 7 weeks. The blood samples were collected after 14 weeks at the end of experimental period. Whereas, the blood samples were collected after first stage to anlysis the blood lipid profile. The blood samples were collected from eye plexuses and into both heparinized tubes to obtain the plasma and into a dry clean centrifuge glass tube without any coagulation to prepare serum. Blood samples were left for15 minutes at room temperature, then the tubes were centrifugation for 15 min at 3000 rpm and the clean supernatant serum was kept frozen at -20˚C until analysis. At end of the experimental period rats were weighed andeuthanized under deep anesthesiausing etherand collection of tissue specimen were performed for further histological examination.

2.6. Determination of Feed Intake, Body Weight Gain and Feed Efficiency Ratio

Body weight gain, feed intake and feed efficiency ratio were estimated as according to [24].

2.6.1. Biochemical Analysis

Serum glucose, total cholesterol (TC), Total triglycerides (TG), high-density lipoproteins (HDL), (urea and BUN), creatinine, uric acid and (aspartate aminotransferase (AST) and Alanine aminotransferase (ALT)) were estimated according to [25, 26, 27, 28, 29, 30, 31 and 32], respectively. Low-density lipoproteins (LDL) and very low-density lipoproteins (VLDL) were calculated as according to [24]. Atherogenic index (AI) and coronary risk index (CRI) were calculated as according to [33 and 34]. Insulinhormone was determined by Insulin Elisa Kit/DRG Diagnostics using ETI Max 3000/DiaSorin (determination in National Institute Diabetic and Endocrine Laboratory).

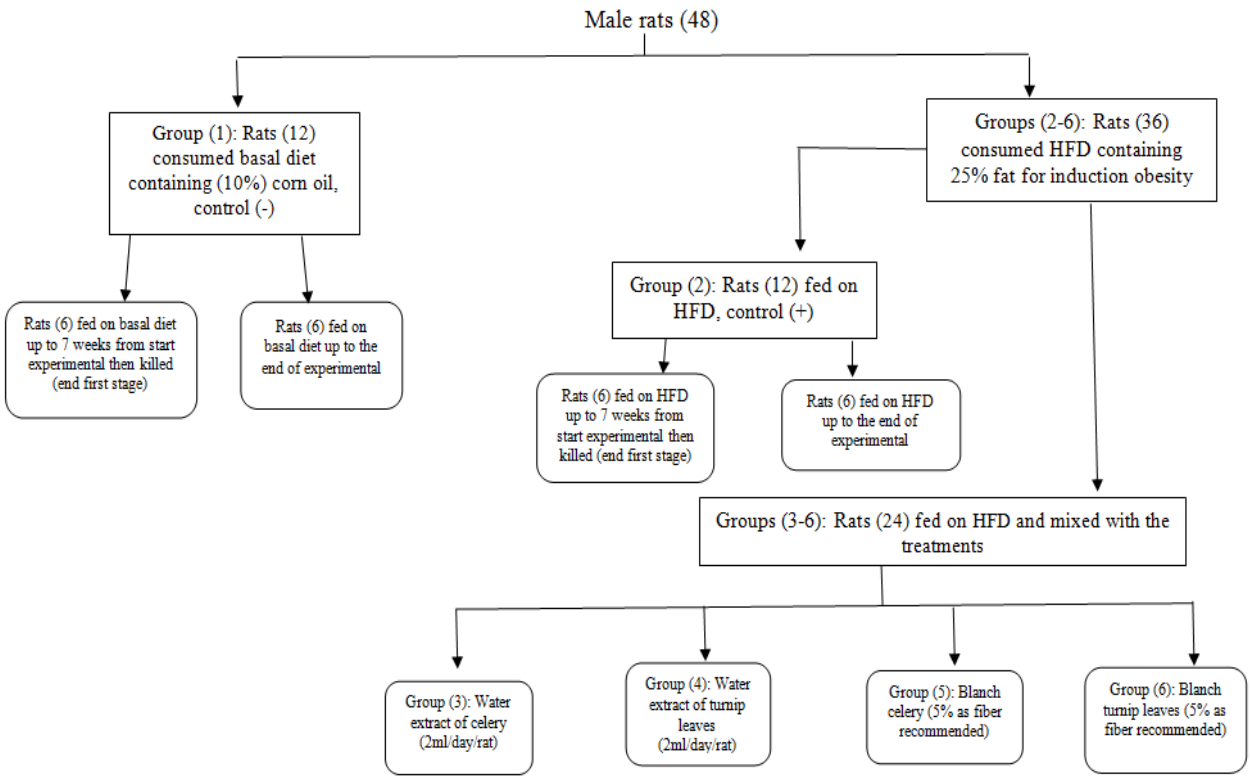

Fig (1). *Presents the design of the nutritional experiment.*

2.6.2. Peritoneal Fat Pad

After first period and at the end of experiment, peritoneal fat pad was dissected from the carcasses, then weight and stored at -20◦C according to the method of [35].

2.6.3. Fat Cell Sized and Area

The morphometric analysis was carried out on routine haematoxlyin and eosin stained slides. Specimens from peritoneal fat pad were analyzed using computerized image analysis to obtain fat cell area ratio between brown and white fat area in renal fat pad described by [36].

The morphometric analysis was performed at the Pathology Department, National Research Center using the Leica Qwin 500 Image Analyzer (LEICA Imaging systems LTD, Cambridge, England) which consists of leica DM-LB microscope with JVC color video camera attached to the computer system leica Q 500 IW. The fat pad cell areas were measured by using damaged area software of the system on a total magnification of (100x).

2.6.4. Histopathological Examination

Tissue specimens were collected from aorta,pulmonary blood vessels,heart,liver and kidney and preserved in 10% neutral buffered formalin ,dehydrated in different grades of alcohol ,cleared in xylene,embedding in paraffin, sectioned with microtome at 5µ thickness and finally stained with hematoxylin and eosin (H&E) and masson`s trichrome (MTC) according to [37] on other hand tissue section of blood vessels were dewaxed in xylene,rehydrated and pretreated with 3 % hydrogen peroxide for blocking the activity of endogenous peroxidase .microwave assited antigen retrieval was done for 20 minutes and sections were incubated overnight at 40 C with primary antibody for vascular endothelial growth factor (VEGF) (catalog MA1-166629 ,Thermo Scientific Co.,UK) was dilutes with phosphate buffer saline (PBS)(1:50) then washed with PBS and incubated with biotinylated mouse secondary antibody (Cat No.32230,ThermoScientific Co.,UK) and finally conjugated with streptavidin-peroxidase .sections were washed with PBS and incubated with diaminobenzidid (DAB) for 5 minutes and counterstained with Mayer`s hematoxylin .

2.6.5. Statistical Analysis

Statistical analyses were carried out by SPSS19 program. Data were expressed as means ± SEM and the Statistical analysis was performed using one-way analysis of variance followed by Duncan's tests.

3. Results

3.1. Chemical Composition

The results in table (2) showed that, the chemical composition of celery and turnip leaves. Crude protein in turnip leaves was higher than celery leaves (25.95% vs 17.94%). The total dietary fiber in celery leaves was higher than turnip leaves (56.14% vs 53.47%). While, crude fiber in celery leaves was lower than turnip leaves (11.96% vs 12.94%). Both celery and turnip leaves are rich in minerals such as Ca, Fe, Mg, and Zn.

Table (2). *Chemical composition of celery and turnip leaves (% on dry weight basis)*

Principle	Celery	Turnip leaves
Moisture	88.53±0.12	86.11±0.17
Protein	17.94±0.13	25.95±0.27
Fat	10.69±0.02	10.89±0.21
Ash	23.19±0.18	20.84±0.20
Crude fiber	11.96±0.26	12.94±0.26
Total dietary fiber	56.14	53.47
NFE	36.22±0.33	29.38±0.31
Energy (Kcal)	313±1.13	319±1.53
Some minerals (mg/100g)		
Ca	992.70±0.56	1289.59±0.71
Fe	42.06±0.17	43.68±0.27
Mg	688.48±1.33	798.02±1.98
Zn	3.50±0.36	6.11±0.03
K	2227.90±3.69	2255.82±5.69
Na	1392.61±8.42	1430.83±2.44

* Nitrogen free extract (NFE) ** Data are presented as means ± SE, n= 3

3.1.1. Effect of Blanching on Fiber Fractions of Celery and Turnip Leaves

The data in table (3) showed that, the effect of blanching on fiber fractions of celery and turnip leaves. Generally, the blanching process cased decrease in fiber fractions content. Lignin was the greatest loss of celery leaves by blanching which was decrease (70.50%) and acid detergent lignin (ADL) (70.94%). While, lignin was decrease in turnip leaves to 57.5%. Meanwhile, the acid detergent lignin (ADL) was the lowest loss in turnip leaves (6.72%). Also, the hemicellulose content was the lowest loss of celery leaves (2.10%).

The results in table (3) indicated that, the blanched turnip leaves were decrease more than blanched celery leaves in acid detergent fiberand neutral detergent fiber (32.89 and 30.10% for turnip vs 6.27 and 21.03% for celery).

Table (3). *Effect of blanching process on fiber fraction for celery and turnip leaves (% on dry weight basis)*

Fiber fractions	Celery	Blanch celery	Turnip leaves	Blanch turnip leaves
Hemicelluloses	17.64	17.27	19.69	12.82
Cellulose	14.65	11.00	17.63	10.82
Lignin	6.44	1.90	2.40	1.02
Acid detergent fiber (ADF)	17.71	16.60	20.10	13.49
Acid detergent lignin (ADL)	6.71	1.95	2.68	2.50
Neutral detergent fiber (NDF)	24.35	19.23	22.16	15.49

Data are presented as means, n= 3

3.1.2. Effect of Blanching Process on Some Phytochemical Contents of Celery and Turnip Leaves

The results of some phytochemical contents are shown in table (4). Generally, the blanching caused decrease in phytochemical were evaluated. Total chlorophyll and total carotenoids were decrease (57.14% and 18.60%) for blanched celery vs (22.89% and 21.21%) for blanched turnip leaves. The results in the same table (4) indicated that, the decreasing in total phenols in blanched celery (39.24%) was more than in blanched turnip leaves (9.35%). While, the decreasing in total flavonoids in blanched turnip leaves (64.17%) was higher than the decreasing in blanched celery (6.57%). Total antioxidant activity (DPPH) was decreased by blanching process 1.34 and 17.30% for celery and turnip leaves, respectively.

Table (4). *Effect of blanching process on some phytochemical contents of celery and turnip leaves (mg/100g FW basis)*

Phytochemicals	Celery	Blanch celery	Turnip leaves	Blanch turnip leaves
Chlorophyll A	0.68^{a}	0.34^{b}	0.61^{a}	0.52^{a}
Chlorophyll B	0.23^{a}	0.05^{c}	0.22^{a}	0.12^{b}
T. Chlorophyll	0.91	0.39	0.83	0.64
T. carotenoids	0.43^{a}	0.35^{b}	0.33^{b}	0.26^{c}
T. phenols*	4569.70^{a}	2776.65^{b}	1196.80^{c}	1084.85^{c}
T. flavonoids*	1510.80^{a}	1411.56^{a}	808.55^{b}	289.73^{c}
Antioxidant activity	84.43^{b}	83.30^{b}	90.37^{a}	74.74^{c}

* Total phenols as Gallic acid and total flavonoids as quercetin ** Each value in a raw followed by the same letter are not significantly different at ($p \leq 0.05$).

3.2. Biological Study

3.2.1. Feed Intake, Gain Body Weight and Feed Efficiency Rati

The results in table (5) indicated that the effect of HFD, HFD containing both fresh blanch celery and turnip leaves and (2ml/day/rat) of water extracts of celery or turnip by stomach tube on feed intake and body weight gain (BWG).The results indicated that the rats fed on basal diet during induce obese stage had significant increase in food intake and feed efficiency ratio compared to other groups fed on HFD to inducing obesity stage. While, the rats fed on HFD control (+) had significant increase ingain body weight compared to negative control. Generally, in the treated stage, the data resulted in the rats fed on HFD had the highest level of feed intake and body weight gain. Tabulated data showed the rats fed on HFD with celery (either water extract or fresh blanch plant) had significant decreasein feed intake compared to rats fed on HFD with turnip leaves (either water extract or fresh blanch plant). Meanwhile, the rats fed on HFD with (5% as fiber) of fresh blanch celery had significant decrease in feed intake and body weight gain and significant increase in feed efficiency ratio.

Table (5). *Effect of highfat diet with celery and turnip leaves diets and their extracts on feed intake, body weight gain and feed efficiency ratio.*

Groups	Induce obese stage			Treatment stage		
	Feed intake (g)	Body weight gain (g)	FER	Feed intake (g)	Body weight gain (g)	FER
Control (-)	33.73^{a}	71.50^{a}	23.12^{a}	22.13^{a}	34.67^{b}	31.28^{b}
Control (+)	29.08^{b}	150.17^{b}	9.49^{d}	23.60^{b}	48.00^{f}	24.09^{f}
Water extract of celery	29.58^{b}	152.66^{b}	9.49^{c}	22.30^{a}	41.67^{e}	26.22^{e}
Water extract of turnip leaves	30.00^{b}	152.33^{b}	9.65^{b}	22.72^{ab}	36.33^{c}	30.64^{c}
Blanch celery	29.11^{b}	152.66^{b}	9.34^{d}	22.62^{a}	14.67^{a}	75.55^{a}
Blanch turnip leaves	30.23^{b}	152.33^{b}	9.72^{b}	23.00^{ab}	38.00^{d}	29.66^{d}

* Each value in a column followed by the same letter are not significantly different at ($p \leq 0.05$).

3.2.2. Effect of High Fat Diet with Celery and Turnip Leaves Diets and their Extracts on Organs Somatic Index

The results in table (6) showed that liver somatic and fat somatic index were lower in rats fed on high fat diet (HFD) with fresh blanch celery compared with control (+). There were significant differences in organs somatic index between groups ($P \geq 0.05$).

Table (6). *Effect of high fat diet with celery and turnip leaves diets and their extracts on organs somatic index.*

Organs	Control (-)	Control (+)	Water extract of celery	Water extract of turnip leaves	Blanch celery	Blanch turnip leaves
Liver weight	7.15ab	9.87d	8.50bcd	8.95cd	6.47a	8.10abc
Liver relative	3.30c	3.30c	2.79ab	3.22bc	2.41a	2.57a
Kidney weight	1.80a	2.90b	2.97b	3.20b	3.17b	3.03b
Kidney relative	0.84a	0.98ab	0.97ab	1.15b	1.18b	0.96ab
Pancreas weight	1.20ab	1.50ab	1.23ab	1.55b	0.93a	1.47ab
Pancreas relative	0.55b	0.50ab	0.40ab	0.55b	0.35a	0.47ab
Heart weight	1.25a	1.30a	1.47a	1.95b	1.37a	1.56a
Heart relative	0.58b	0.43c	0.48ab	0.70a	0.51ab	0.50ab

* Each value in a raw followed by the same letter are not significantly different at ($p \leq 0.05$)

3.2.3. Effect of HFD with Celery and Turnip Leaves Diets and their Extracts on Lipid Profile Content

The results in table (7) demonstrated thateffect of HFDto induce obese rats and effect of HFDwith celery or turnip leaves on lipid profile content. After induce obese stage, the results indicated that rats fed on HFD had significant increase in TC, TG, LDL-C and VLDL-C compared to rats in negative control. While, after treatment stage, showed that addition of celery and turnip leaves both water extract and blanched plants (as 5% fiber FW) decreased significantly in TC, TG, LDL-C and VLDL-C compared to positive control. Also, the results showed that water extract (both celery and turnip leaves) were significant decrease in lipid profile analysis. Total cholesterol/HDL-C ratio were increased significantly in rats fed on high fat diet while it statistically decreased in rats consumed both water extract and fresh blanched plants of celery and turnip leaves.Similarly, celery and turnip leaves (both water extract and blanch plant) caused reductions in the atherogenic and coronary risk index (AI and CRI) in table (7). The rats fed on HFD with water extract decrease of AI and CRI more than blanch plant. These results may be due to bioactive compounds in water extract such as phenolic compounds.

Table (7). *Effect of high fat diet with celery and turnip leaves diets and their extracts on lipid profile content*

Items	Control (-)	Control (+)	Water extract of celery	Water extract of turnip leaves	Blanch celery	Blanch turnip leaves
Total cholesterol I	100.42^{a}	120.46^{b}	124.32^{b}	125.05^{b}	127.57^{b}	127.09^{b}
Total cholesterol II	102.24^{a}	172.77^{d}	116.12^{ab}	126.27^{bc}	132.94^{bc}	144.98^{c}
Total triglycerides I	162.95^{a}	234.95^{b}	232.62^{b}	236.95^{b}	235.04^{b}	234.70^{b}
Total triglycerides II	122.73^{a}	258.09^{c}	136.97^{a}	107.69^{a}	195.96^{b}	220.38^{bc}
HDL-C I	51.59^{a}	37.05^{b}	37.81^{b}	35.21^{b}	41.17^{b}	36.40^{b}
HDL-C II	59.85^{abc}	53.20^{c}	59.73^{abc}	70.11^{a}	65.36^{ab}	57.93^{bc}
LDL-C I	13.24^{a}	36.42^{b}	39.99^{b}	42.45^{b}	39.39^{b}	42.75^{b}
LDL-C II	17.84^{a}	67.95^{d}	29.00^{b}	34.62^{b}	28.39^{b}	42.36^{c}
VLDL-C I	35.59^{a}	46.99^{b}	46.52^{b}	47.39^{b}	47.01^{b}	46.94^{b}
VLDL-C II	24.55^{a}	51.62^{c}	27.39^{a}	21.54^{a}	39.19^{b}	44.48^{bc}
CRI – I**	1.95^{a}	3.25^{b}	3.29^{b}	3.55^{b}	3.10^{b}	3.49^{b}
CRI - II**	1.71^{a}	3.25^{d}	1.94^{ab}	1.80^{a}	2.03^{b}	2.50^{c}
AI – I***	o.26	0.98	1.06	1.21	0.96	1.17
AI – II***	o.30	1.28	0.49	0.49	0.43	0.73

* Each value in a raw followed by the same letter are not significantly different at ($p \leq 0.05$). **CRI; coronary risk index ***AI; athearogenic index

3.2.4. Effect of High Fat Diet with Celery and Turnip Leaves Diets and their Extracts on Kidney and Liver Functions

The results in table (8) revealed that the rats in positive control had significant increase in liver and kidney functions compared to rats in negative control. However, the rats fed on HFD with celery or turnip leaves (either water extract or fresh blanch plant) resulted in significant decrease in liver and kidney functions compared to positive control.

Table (8). *Effect of high fat diet with celery and turnip leaves diets and their extracts on kidney and liver functions*

Items	Control (-)	Control (+)	Water extract of celery	Water extract of turnip leaves	Blanch celery	Blanch turnip leaves
Serum urea	60.61^{cd}	69.37^{e}	45.86^{a}	56.32^{bc}	67.15^{de}	50.04^{ab}
Serum BUN*	28.31^{cd}	32.40^{e}	21.42^{a}	26.30^{bc}	31.36^{de}	23.37^{ab}
Serum uric acid	3.35^{a}	3.40^{a}	3.17^{a}	2.93^{a}	3.04^{a}	3.22^{a}
Serum creatinine	0.50^{a}	0.40^{a}	0.44^{a}	0.39^{a}	0.44^{a}	0.33^{a}
ALT (U/L)**	17.00^{a}	45.50^{c}	27.00^{b}	28.33^{ab}	22.00^{ab}	23.33^{b}
AST (U/L)**	26.00^{ab}	37.67^{c}	31.00^{bc}	29.33^{ab}	26.00^{ab}	22.00^{a}

* BUN; Urea nitrogen: To convert the result from urea to urea nitrogen multiply the result by 0.467
** ALT; Alanine aminotransferase, AST; Aspartate aminotransferase. *** Each value in a raw followed by the same letter are not significantly different at ($p \leq 0.05$).

3.2.5. Effect of Celery and Turnip Leaves Diets on Fasting Plasma Glucose and Insulin Concentrations at the end of Experimental

The results in figure (2) showed that, fasting serum glucose levels were significantly decrease in negative control compared to other treatments. Fasting serum glucose levels were significant increase in rats fed on HFD with celery or turnip leaves compared to control positive. However, insulin concentration in rats fed on HFD with fresh blanch turnip leaves were significantly higher than that fed on HFD with fresh blanch celery ($p \leq 0.05$). the rats fed on HFD had the lowest level of insulin concentration. While, rats fed on HFD with fresh blanch celerly and turnip leaves were higher than rats fed on HFD with water extract. This result may be due to fiber content incelery and turnip leaves.

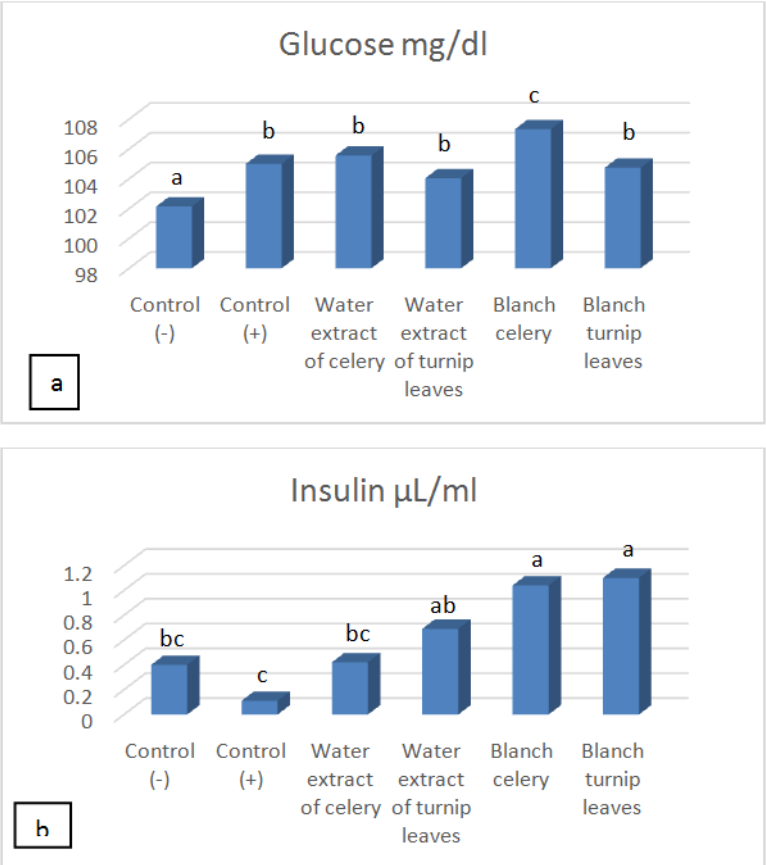

Fig. (2). *Effect of celery and turnip leaves diets and their ectracts on fasting serumglucose and insulin concentrations in the end experimental period. A. serum glucose levels and B. serum insulin concentrations in rats.*

3.2.6. Effect of Celery and Turnip Leaves Diets and their Extracts on Adipose Tissue Mass in HFD- Induced Obese

The present study, the weight of adipose tissue mass, retroperitoneal fat and epididymal adipose tissue in treated groups by celery and turnip leaves (both water extract and blanched plants) were significantly decreased compared to the HFD-control group. The rats fed on both water extract of celery and blanched celery were decrease more than rat fed on both water extract of turnip and blanched turnip leaves for no. of pad fat cells.

Table (9). *effect of feeding by celery and turnip leaves on total body fat, retroperitoneal fat and epididymal adipose tissue*

Groups	Adipose tissue mass (g)	Relative ratio	Retroperitoneal fat (g)	Epididymal adipose tissue (g)	No. of pad cell (n= 20µm)
Control (-)	2.95a	1.36a	1.80a	1.15a	30
Control (+)	8.83c	2.72c	4.80c	4.03bc	66
Water extract of celery	8.60c	3.23d	4.97c	3.63b	32
Water extract of turnip leaves	8.00c	3.22d	4.33c	3.67b	43
Blanched celery	5.37b	2.00b	3.07b	2.30ab	31
Blanched turnip leaves	10.06d	3.14cd	5.61d	4.45c	49

* Each value in a column followed by the same letter are not significantly different at ($p \leq 0.05$).

3.3. Histopathological Findings

Concerning HFD and treated groups, various histopathological alterations have been observed in aorta, liver, kidney and pancreas compared to control group in figures (3 to 9). Figure (3) showed normal structure of rat's aorta for negative control (fig., 3a). While, positive control which fed on HFD revealed vacuolation of tunica media (fig., 3b). Normal aorta (fig., 3c and 3d) for groups which fed on HFD with 2ml/day/rat of water extract of celery and turnip leaves, respectively. The rat's aorta from group which fed on HFD with 5% as fiber of blanched celery showed vacuolation of tunica media (fig., 3e). The rat's aorta from group which fed on HFD with 5% as fiber of blanched turnip leaves showed thickening and vacuolation of tunica media (fig., 3f).

Liver findings:

Figures (4,5 and 6) showed the histopathological alterations in rat's liver. The examination of control groups were show in fig (4). The negative control which fed on basal diet showed normal histopathological structure of hepatic lobule (fig., 4a) and kupffer cell activation (fig., 4b). While, positive control which fed on HFD showed fatty degeneration of hepatocytes (fig., 4c) and congestion of central vein and hepatic sinusoids (fig., 4d). Moreover, the histopathological alterations for groups which fed on HFD with 2ml/day/rat of water extract of both celery and turnip leaves were show in (fig., 5). Rat's liver from group treated by HFD with 2ml/day/rat of celery showed kupffer cells activation and fatty degeneration of hepatocytes (fig., 5a and b). While, rat's liver from group treated by HFD with2ml/day/rat of turnip leaves showed fatty degeneration of hepatocytes, congestion of central vein and kupffer cells activation (fig., 5c and d). The slides in fig (6) showed the histopathological alterations for liver from groups which fed on HFD with (5% as fiber) of either blanch celery or turnip leaves. The rat's liver from group fed on HFD with 5% fiber of blanched celery showed focal hepatic haemrrhage associated with leucocytes infiltration (fig. 6a) and few leucocytes in hepatic (fig. 6b). While, the rat's liver from group fed on HFD with 5% fiber of blanched turnip leaves showed congestion of central view and kupffer cells activation (fig. 6c) and slight activation of kupffer cells (fig. 6d).

Kidney Findings: Lesions in kidney were normal histopathological structure of renal parenchyma (fig. 7a). Concerning HFD group perivascular mononuclear cells infiltration was detected (fig. 7b), pertubular inflammatory cells infiltration (fig. 7c) and vacuolations of renal tubular epithelium and per tubular inflammatory cells infiltration (fig. 7d). The treated groups by celery and turnip leaves (either water extract or blanched plant) are shown in fig (8). The rat's kidney from group fed on HFD with 2ml/day/rat revealed vacuolation of epithelial liming renal tubules and endothelial liming glomerular tuft (fig. 8a) and apparent normal renal parenchyma (fig. 8b). Rat's kidney from group fed on HFD with 2ml/day/rat showed focal interstitial nephritis (fig. 8c) and marked thickening in parietal layer of Bowman's capsule, vacuolation of renal tubular epithelium and congestion of intertubular blood capillaries (fig.8d). While, rat's kidney from group fed on HFD with 5% fiber of blanched celery showed cystic dilatation of renal tubules (fig. 8e) and rat's kidney from 5% of blanched turnip leaves showed no histopathological changes (fig. 8f).

Pancreas findings: Concerning pancreas organ, various histopathological alterations have been observed in fig (9). The negative control showed no histopathological changes in pancreas (fig. 9a), and positive control showed congestion of blood vessel (fig. 9b). Rat's pancreas from group fed on HFD with 2ml/day/ rat of water extract of celery showed perivascular aggregation of neutrophils (fig. 9d), and rat's pancreas from group fed on HFD with 2ml/day/rat of water extract of turnip leaves showed hyperplasia and hypertrophy of islets of Langerhans's (fig. 9e). While, rat's pancreas from group fed on 5% fiber of blanched celery showed vacuolation of β-cells of islets of Langerhans's (fig. 9f) and hyperplasia and hypertrophy of β-cells of islets of Langerhans's (fig, 9g). Rat's pancreas from group fed on HFD with 5% fiber of

blanched turnip leaves showed no histopathological changes (fig. 9h).

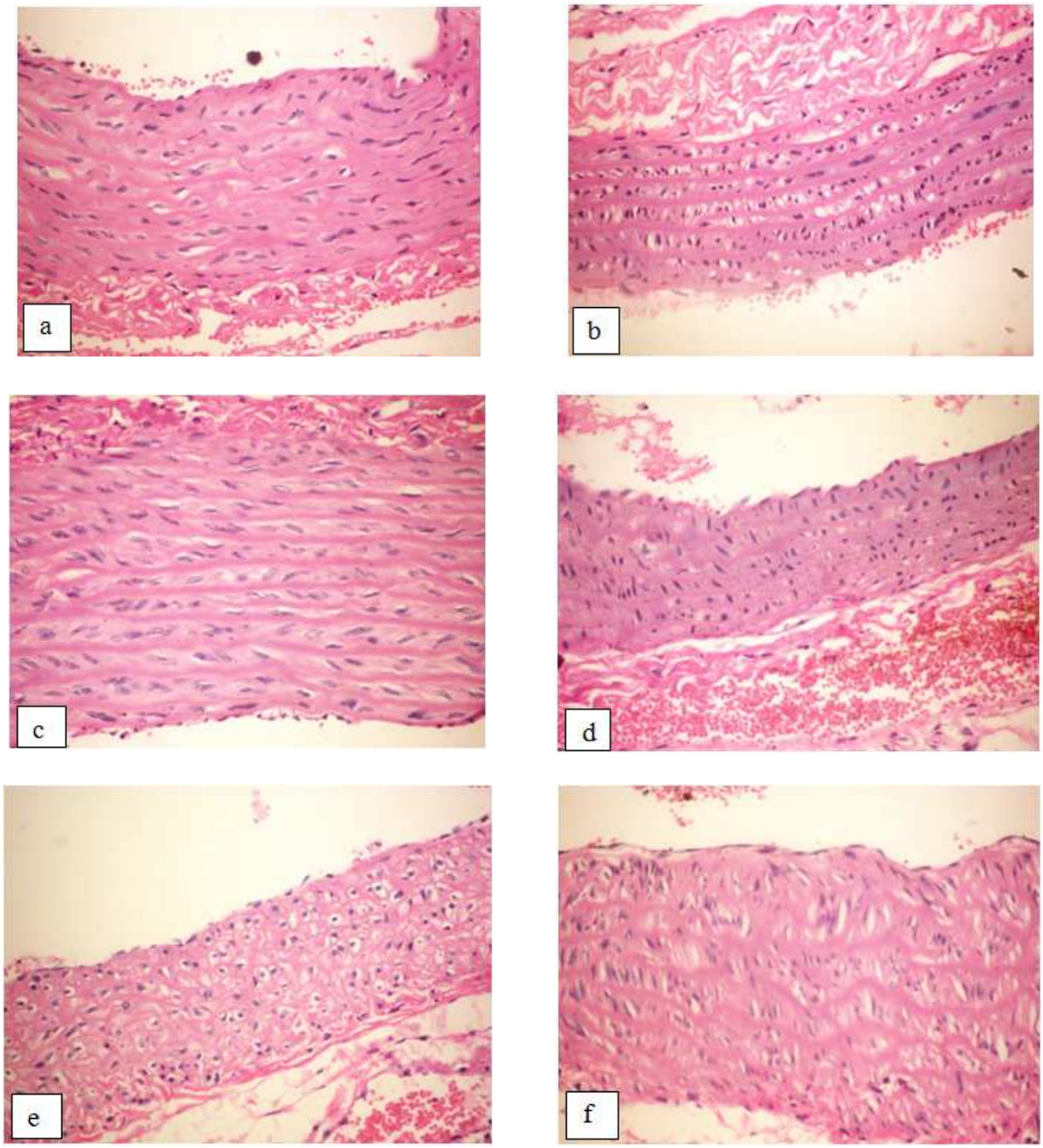

Fig. (3). *aorta of rats fed on basal, high fat diet and HFD with celery or turnip leaves: a) normal aorta of rats from negative control (H&E). b) Aorta of rats from positive control showing vacuolations of tunica media (H&E). c) Normal aorta of rats from group fed on HFDwith 2ml/day/rat water extract of celery (H&E). d) Normal aorta of rats from group fed on HFD with 2ml/day/rat water extract of turnip leaves (H&E). e) Aorta of rats from group fed on HFD with fresh blanch celery showing vacuolations of tunica media (H&E). f) Aorta of rats from group fed on HFD with fresh blanch turnip leaves showing thickening and vacuolations of tunica media (H&E).*

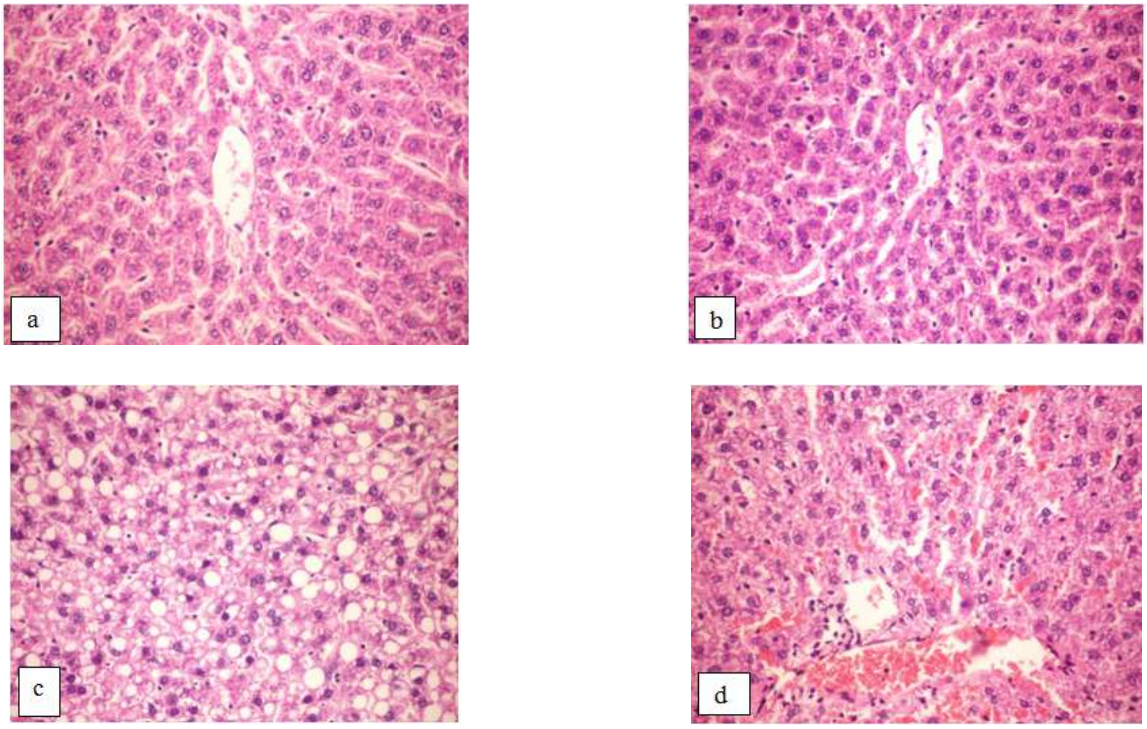

Fig (4). *Rat's liver of different controls (negative and positive control): a) Rat's liver of negative control showing normal histological structure of hepatic lobule (H&E). b) Rat's liver of negative control showing kupffer cells activation (H&E). c) Rat's liverwhich fed of HFD group showing fatty degeneration of hepatocytes (H&E). d) Rat's liverwhich fed of HFD group showing congestion of central vein and hepatic sinusoids (H&E).*

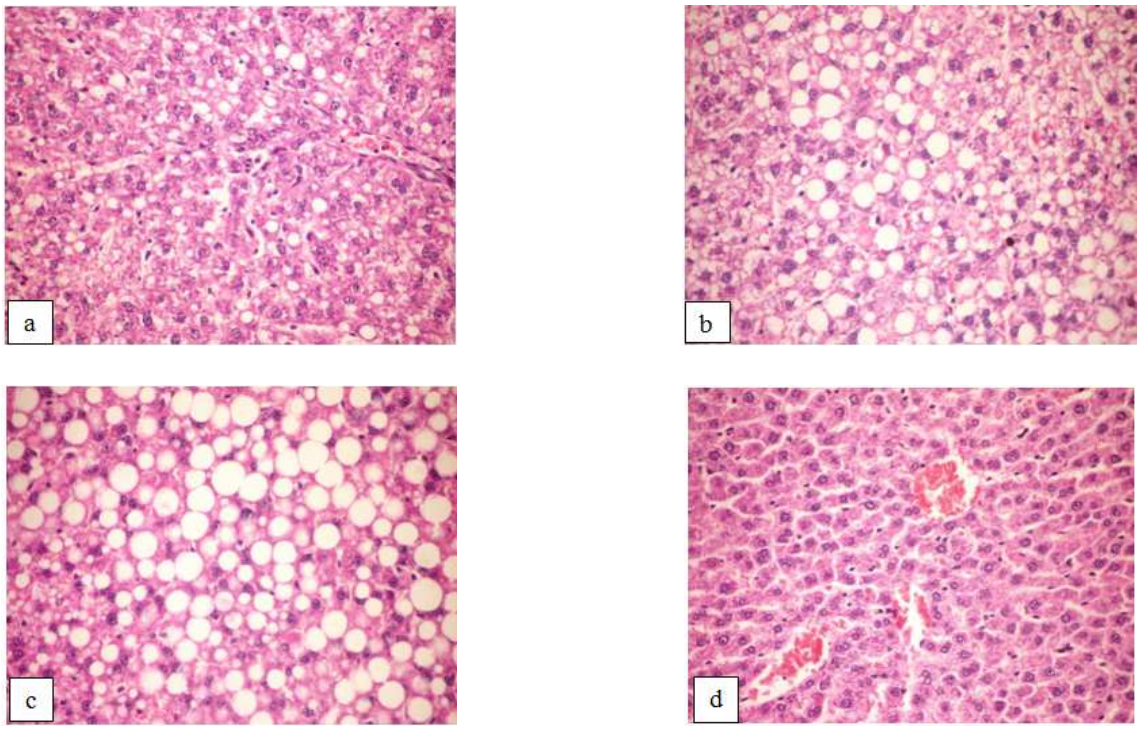

Fig (5). *Rat's liver of different treated groups: a) Rat's liver of rats from group fed on HFD with 2ml/day/rat water extract of celery showing kupffer cells activation and fatty degeneration of hepatocytes (H&E). b) Rat's liver of rats from group fed on HFD with 2ml/day/rat water extract of celery showing fatty degeneration of hepatocytes (H&E). c) Rat's liver of rats from group fed on HFD with 2ml/day/rat water extract of turnip leaves showing fatty degeneration of hepatocytes (H&E). d) Rat's liver of rats from group fed on HFD with 2ml/day/rat water extract of turnip leaves showing congestion of central veins and kupffer cells activation (H&E).*

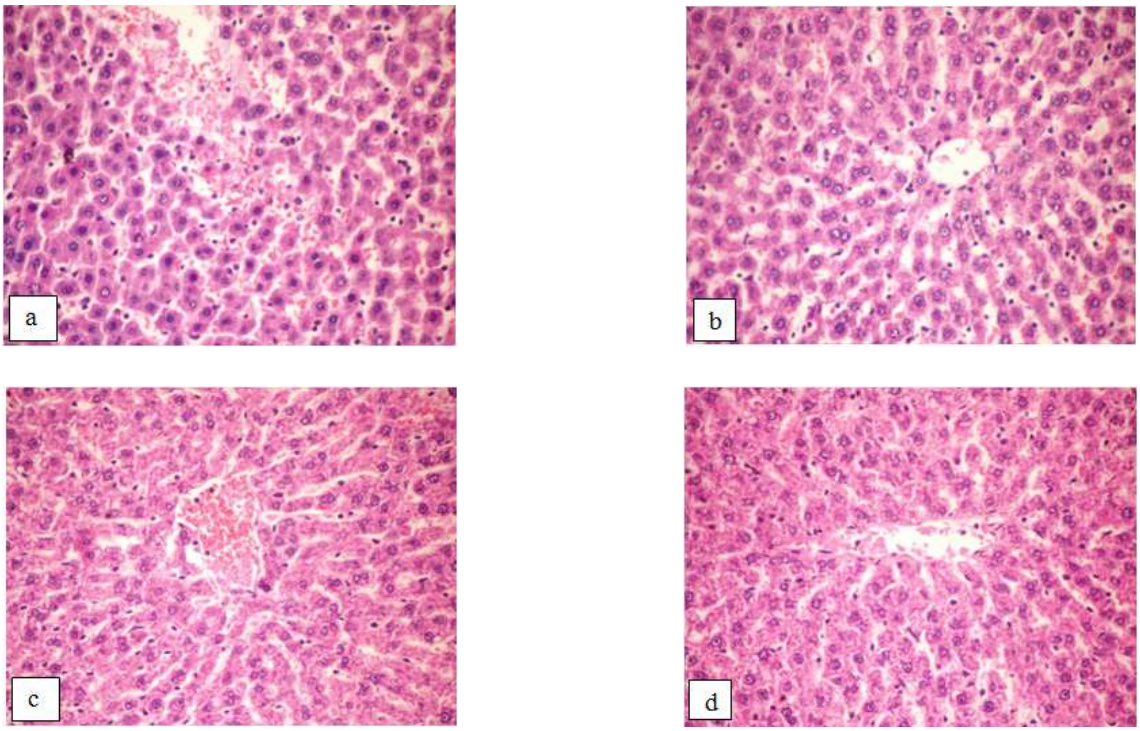

Fig (6). *Rat's liver of different treated group (as 5% fiber of celery or turnip leaves): a) Rats liver of rats from group fed on HFD with fresh blanch celery showing focal hepatic haemrrhage associated with few leucocytes infiltration (H&E). b) Rat's liver of rats from group fed on HFD with fresh blanch celery showing few leucocytes in hepatic (H&E). c) Rat's liver of rats from group fed on HFD with fresh blanch turnip leaves showing congestion of central vein and kupffer cells activation (H&E). d) Rat's liver of rats from group fed on HFD with fresh blanch turnip leaves showing slight activation of kupffer cells (H&E).*

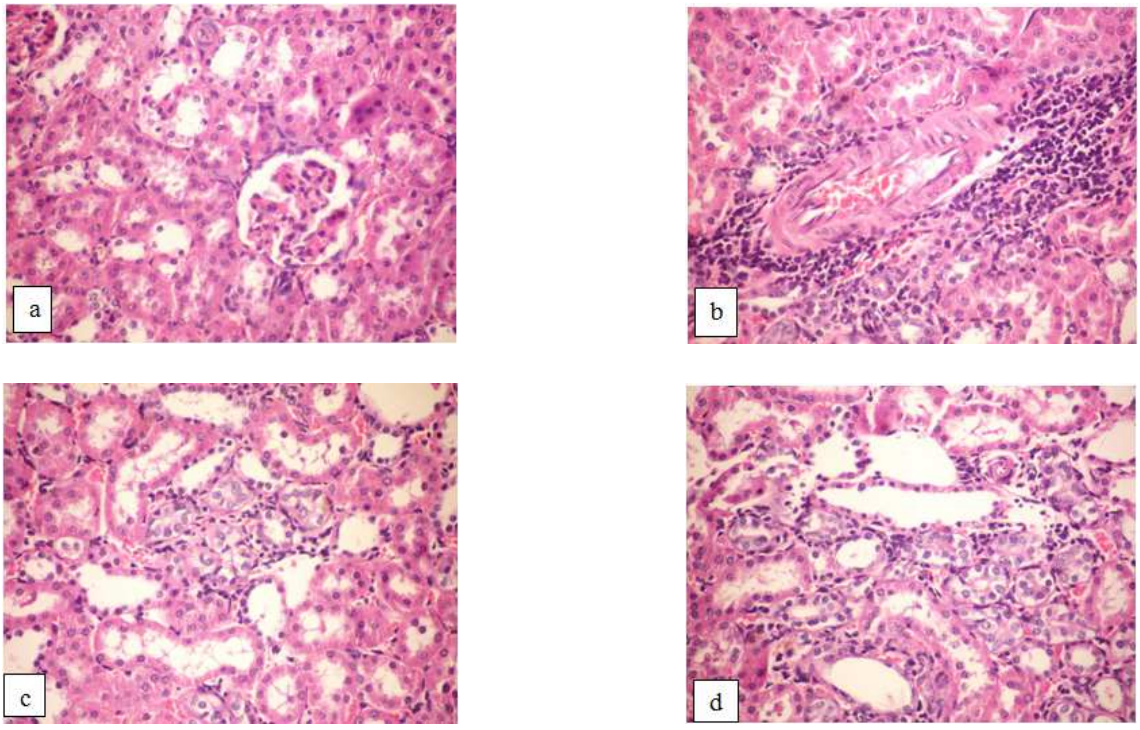

Fig (7). *Rat's kidney of different controls (negative and positive control): a) Rat's kidney of rats from negative control showing the normal histological structure of renal parenchyma (H&E). b) Rat's kidney of rats from positive control which fed on HFD showing perivascular mononuclear cells infiltration (H&E). c) Rat's kidney of rats from positive control which fed on HFD showingper tubular inflammatory cells infiltration (H&E). d) Rat's kidney of rats from positive control which fed on HFD showing vacuolations of renal tubular epithelium and per tubular inflammatory cells infiltration (H&E).*

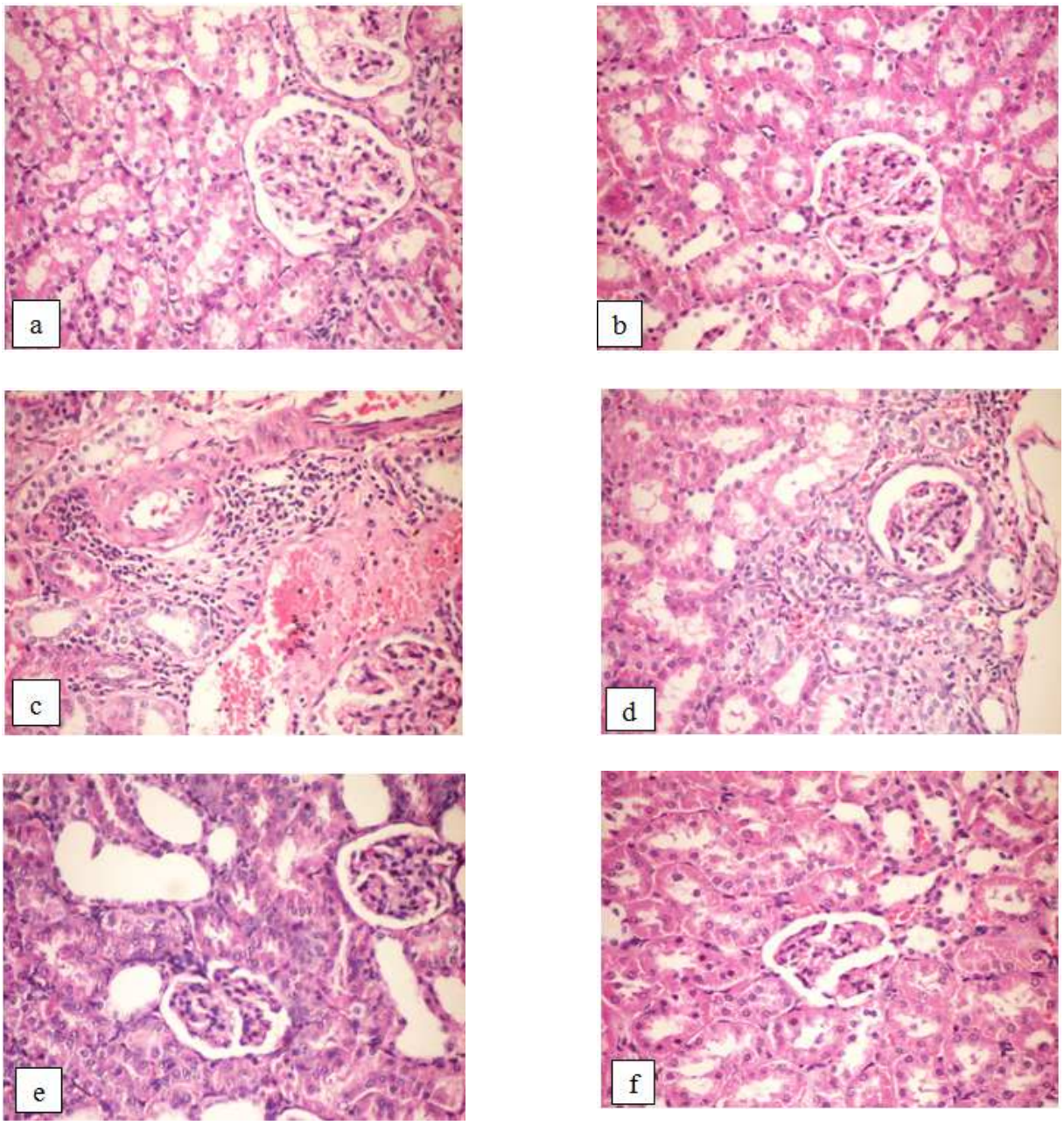

Fig (8). *Rat's kidney of different treated groups:a)Rat's kidney of rats from group fed on HFD with 2ml/day water extract of celery showing vacuolation of epithelial liming renal tubules and endothelial liming glomerular tuft (H&E). b) Rat's kidney of rats from group fed on HFD with 2ml/day/rat water extract of celery showing apparent normal renal parenchyma (H&E). c) Rat's kidney of rats from group fed on HFD with 2ml/day/rat water extract of turnip leaves showing focal interstitial nephritis (H&E). d) Rat's kidney of rats from group fed on HFD with 2ml/day/rat water extract of turnip leaves showing marked thickening in parietal layer of Bowman's capsule, vacuolation of renal tubular epithelium and congestion of intertubular blood capilleries (H&E). e) Rat's kidney of rats from group fed on HFD with fresh blanch celery showing cystic dilatation of renal tubules (H&E). f) Rat's kidney of rats from group fed on HFD with fresh blanch turnip leaves showing no histopathological changes (H&E).*

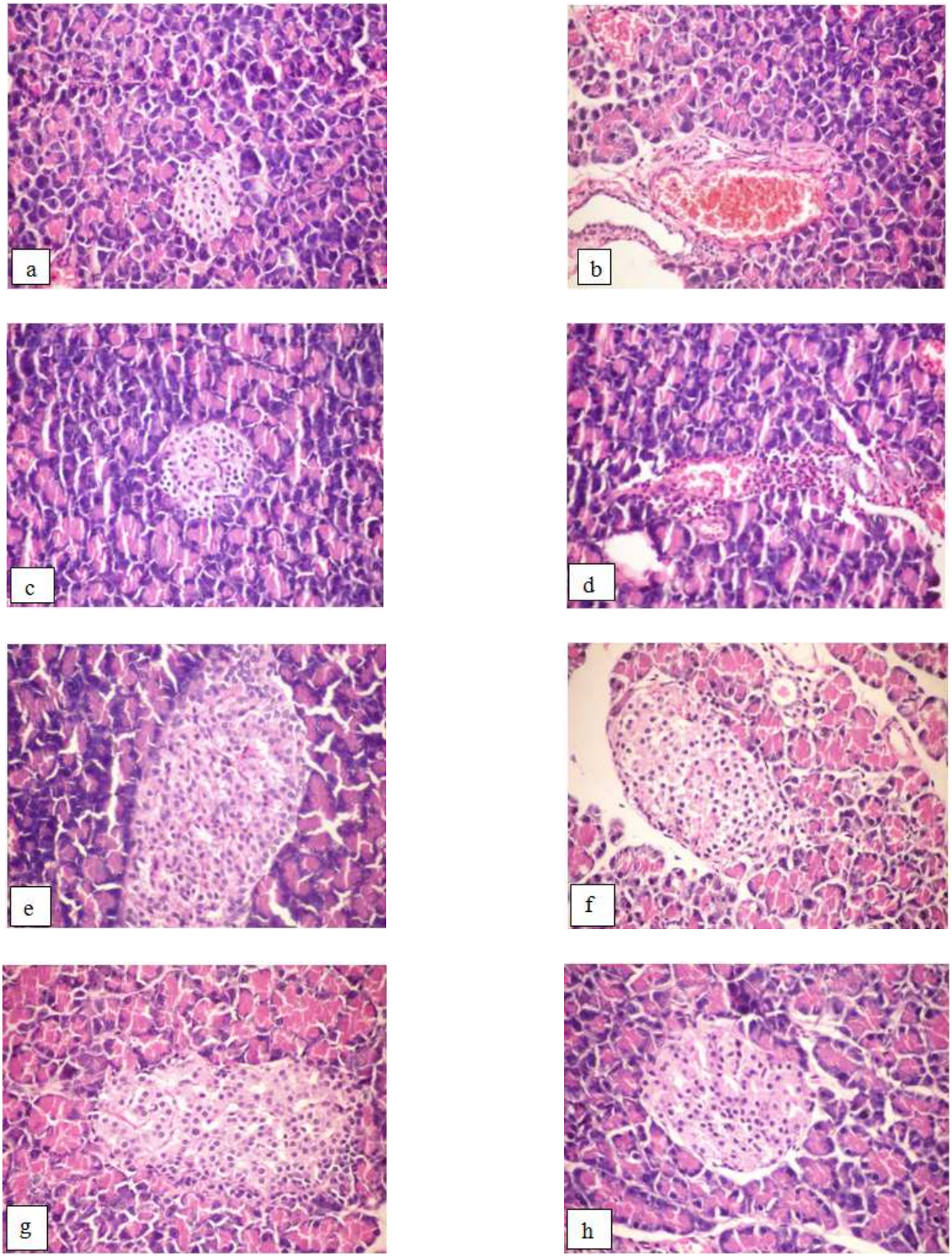

Fig (9). *Rat's pancreas of different treated groups: a) Rat's pancreas of rats from negative control showing normal histological structureof Langerhans's (H&E). b) Rat's pancreas of rats from positive control showing congestion of blood vessel (H&E). c) Rat's pancreas of rats from group fed on HFD with 2ml/day/rat water extract of celery showing no histopathological changes (H&E). d) Rat's pancreas of rats from group fed on HFD with 2ml/day/rat water extract of celery showing perivascular aggregation of neutrophiles (H&E). e) Rat's pancreas of rats from group fed on HFD with 2ml/day/rat water extract of turnip leaves showing hyperplasia and hypertrophy of islets of Langerhans's (H&E). f) Rat's pancreas of rats from group fed on HFD with fresh blanch celery showing vacuolation of β-cells of islets of Langerhans's (H&E). g) Rat's pancreas of rats from group fed on HFD with fresh blanch celery showing hyperplasia and hypertrophy of β-cells of islets of Langerhans's (H&E). h)) Rat's pancreas of rats from group fed on HFD with fresh blanch turnip leaves showing no histopathological changes (H&E).*

4. Discussion

Leafy green vegetables and fruits have generated interest worldwide as they exhibit multiple benefits for health of human beings. Carotenoids present in agricultural and horticultural produce, have provitamin-A activity and are potent antioxidants and modulate the pathogenesis of several chronic degenerative diseases [7]. In present results showed the celery is a good source of minerals and dietary fiber. The results of chemical composition of celery are in the line with [12 and 38]. Moreover, [39] found that total dietary fiber in celery was higher than dietary fiber in turnip leaves.

Blanching in water caused a decrease in the amount of soluble solids, chlorophylls, antioxidant capacity and total phenolics. The results in table (3) are agree with [40] who concluded, blanching and frozen storage resulted in several changes in quality and nutritional parameters of turnip greens.Blanching time also had a significant effect on the turnip green composition. Short time processing result in a high retention of chlorophylls. The turnip greens blanched in water for 1 min lost about 7% of total chlorophyll. Some authors have shown that thermal inactivation of enzymes limits the degradation of chlorophylls. Another positive effect of blanching is the deaeration, which contributes to the preservation of pigments. Other publications showed losses of chlorophyll between 12 and 66% during blanching. These losses varied according to the species as well as the part of the plant used and the heat treatment [41].

Total phenols compoundswere a higher content in celery than turnip leaves and decreased by blanching in water as shown in table (3). These results are line with [40] reproted that,blanching caused a decrease of total phenolic content in turnip greens; this effect may be due to thermal degradation and leaching to water. Blanching is known to affect the phenolic content of some fruits and vegetables. Great losses of phenolics in vegetables during blanching are due to the dilution of these compounds in water. About, 12-26% of phenolic compounds were lost into the cooking water after different vegetables had been blanched for 1 min [42]. These losses are of the same magnitude as reported by [43] in *B. oleracea* L. ssp. botrytis. In contradiction to these results, [44] showed a slight increase in total phenolics in spinach, green beans, pepper and broccoli following different types of cooking methods. This could be explained by the fact that heat treatment increased the level of free flavonols [45]. Thermal treatments can also induce the formation of compounds with new antioxidant properties, e.g. Maillard reaction products [46].

In addition, total antioxidants level in turnip leaves (90.73%) was higher than in celery (84.43%) and blanching caused decrease in both. These results are agree with [40] who found, the unblanched turnip greens (control sample) exhibited a higher percentage of inhibition. The results showed a wide variation of antioxidant activity changes after blanching. According, [47] found the antioxidant losses during the blanching may be different according to the differences in process conditions and morphological and nutritional characteristics of vegetable species. And, [48] reported that, Brassica spp. have a high antioxidant capacity.

Dietary fiber intake provides many health benefits. Individuals with high intakes of dietary fiber appear to be at significantly lower risk for developing coronary heart disease, stroke, hypertension, diabetes, obesity, and certain gastrointestinal diseases. Increasing fiber intake lowers blood pressure and serum cholesterol levels. Increased intake of soluble fiber improves glycaemia and insulin sensitivity in non-diabetic and diabetic individuals. Fiber supplementation in obese individuals significantly enhances weight loss [5].

The present study aimed to investigate the protective effect of feeding on fiber from some vegetables such as celery and turnip leaves on high fat diet (HFD).In the present study, the rats fed the HFD for fourteen weeks showed obesity, which was associated with significantly increased body weight and development of dyslipidemia. After seven weeks induced obese, there were no significant differences in feed intake. While, after seven weeks treatment with both celery and turnip leaves (either water extract or blanched plant), body weight again and serum LDL-C levels were significantly lower than those of control (+). This effect might be attributed to the content of the tested sample in the diet, since it is possibly due to their similar cellulose contents [49]. Also, flavor and odor of the turnip leaves could be anther factor. These results were supported by those reported by [50, 51 and 52] they illustrated that turnip leaves were characterized by a particular sulfurous aroma, pungent flavor and a bitter taste. However, the change in body weight gain might be attributed to the low feed intake.This is agreement with those reported by [5], keen observers have noted that high-fiber foods were more filling than low-fiber foods. Meals containing pectin resulted in delayed gastric emptying and enhanced satiety. Animal experiments indicate that high fiber intake is associated with less weight gain than low fiber intake. Intake of fiber tends to delay gastric emptying and create a sense of fullness. Increased fiber intakes are associated with increases in satiating gut hormones. According [53] reported that, a combination of factors (Large LDL and small VLDL fractions and mean LDL particle size) and mechanisms appears to contribute to the reduction in lipids observed after the consumption of barley. Mechanisms suggested for the reduction in cholesterol after increased consumption of soluble fiber include increased excretion of bile acids or neutral sterols, increased catabolism ofLDL cholesterol, and reduced absorption of fat. Increased viscosity of the gastric and intestinal contents can delay gastric emptying, decrease nutrient absorption, and interfere with micelle formation. Soluble fibers were shown to be fermented in the colon [54] and thus to give rise to short-chain fatty acids that can be absorbed and may inhibit hepatic cholesterol synthesis. In addition to the soluble fiber, barley contains a wide range of phytochemicals, some of which are being investigated for their effect on metabolism. According, [6] reported that the differing in quantity of soluble vs

insoluble fiber may have different effects on body weight gain and carbohydrate metabolism. Specifically, the data suggest that high-fat diets containing a larger percentage of soluble fiber, such as provided in the diet with sugarcane fiber or psyllium, resulted in lower glucose and insulin levels in this animal model. Specifically, fasting plasma glucose and insulin levels during the study were observed to be significantly lower in the SCF and PSY groups than in the CEL groups. The mechanism is not precisely known, but a contributing factor may be altering the rate of glucose absorption in the gut. Dietary fiber, particularly soluble fiber found in barley and oats, may slow digestion and absorption of carbohydrates and hence lower blood glucose and insulin levels [55].

As expected the present results revealed that the positive control had significantly increased serum levels TC, TG, LDL-C and VLDL-C. In addition, significant decreased in serum levels lipid profiles, liver and kidney functions when feeding by both celery and turnip leaves (either water extract or blanched plants). These changes may be related to the phenolic compounds in both celery and turnip leaves and its properties as antioxidant activity. These results are confirmed by finding [24] who found that, rats fed on high cholesterol diet with different levels (5, 10 and 15 %) of turnip leaves powder showed significant reduction in serum levels of TG, TC, LDL-C, VLDL-C, ALT, AST, creatinine and urea compared to the positive control group. Nutrition education programs are needed to inform the public about the importance of turnip leaves in decreasing the risk of heart disease. The consumption of *Brassica* vegetables has been related to human health due to their phytochemicals, which induce a variety of physiological functions including antioxidant activity, enzymes regulation and apoptosis control [56]. Also, [56 and 57] they reported the phenolic compounds are a high content in turnip leaves such as flavonols. While, [58] found that,aqueous extract of celery caused significant reduction in serum total cholesterol level in hypercholesterolemic rats.After feeding rats during 8-week study, a preliminary chemical characterization of butanol and aqueous fractions by thin layer chromatography (TLC) showed the presence of sugars and amino acids. There is a possibility that polar compounds with sugar or amino acid side chains(s) could contribute to the hypocholesterolaemic action of celery extract. Also, celery contain Vitamin C which reduce the free radicals in the body. And, Belal [59] who found that feeding on diets supplemented by (10% of each celery, chicory, barley and 15% combination of them; 5% of each) decreased TC, TG, LDL-C, VLDL-C and liver and kidney functions compared to positive control. And, [60] who found the rats treated celery powder and celery extract (2.5 and 5 mg/Kg body weight) by stomach tube showed a high significant in ALT, creatinine, urea and uric acid compared to negative control. The effect of feeding by celery and turnip leaves (bothwater extract and blanch plant)on atherogenic index (AI) and coronary risk index (CRI) indices in also notable. The ratio of TC/HDL-C (AI) and ratio of LDL-C/HDL-C (CRI) are storng and reliable indicators of whether or cholesterol is not deposited into tissues or metabolized and excreted [61]. Our present study, results showed the treatment by celery and turnip leaves caused profound reductions in (AI and CRI) in HFD-induced obese rats. These results are line with [62].Our results indicated that the continuous consumption of HFD may play a role in the development of hepatic steatosis associated with obesity, and celery and turnip leaves (both water extract and blanched plant) exhibits a hepatoprotective effect, indicated with improved liver weight. In the HFD-control (+), the activities of liver function markers, including serum AST and ALT, were significantly elevated relative to those in the basal diet group and improved by celery and turnip leaves supplementation. These results suggest that treatment by celery and turnip leaves may attenuate the development of hepatic steatosis and its where potentially effective in ameliorating fatty liver in HFD-induced obese rats.

The results indicated that after induce-obesity (first 7 weeks) the rats fed on HFD had adipose tissue mass and no. of pad cell higher than rats in negative control, and less than the results after period of experimental; 14 weeks (data did not show).

Obesity is characterized by increased adipose tissue mass that results from both increased fat cell number and increased fat cell size. Adipose tissue is a dynamic organ that plays an important role in energy balance and changes in mass according to the metabolic requirements of the organism [63]. Excess energy intake and reduced energy expenditure results in abnormal excessive growth of white adipose tissue (WAT), which can lead to the development of obesity [64]. Epididymal adipose tissue in the rat is generally considered to be WAT with a characteristic structure and function [65]. The present study, white adipose tissue (WAT) in HFD-induced obese rats was decrease by treatments by celery and turnip leaves compared to the HFD control (+). These results suggest that the fiber from celery and turnip leaves may prevent the accumulation of white adipose tissue (WAT) in HFD obese rats or anti-obesity effects of celery and turnip leaves (both water extract and blanch plant) bioactive compounds may be elicited by regulating the expressions of lipogenesis-related genes in WAT [66].These results are line with [62] who found *A. capillaris* extracts may prevent the accumulation of white adipose tissue (WAT) in HFD-induced obese rats.

Pervious studiesaimed tothe effect ofHFD on liver histopathology only. But, the present study investigation HFD on liver, kidney, heart and pancreas. So, the our results are line with [58] who recorded that in a rat study assessing the effectof celery extract on liver, rats drinking aqueous celeryextract for eight weeks showed no undesirable sideeffects in liver functions, [59] found the diet supplemented with celery, chicory and barley produce an excellent effect on the histology of liver and [62] whorecorded that in a rat study assessing the effectof *A. capillaris* extracts on liver, rats drinking aqueous *A. capillaris* extracts for 13 weeks showed no undesirable sideeffects in liver histopathology which prevented of hepatic fatty deposition in liver.

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