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Effect of Biologically Active Substances in *Cichorium* on Biochemical Changes in Obese Rats

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Abstract

The Cichorium plant is considered one of the medicinal plants that have been known since ancient times, as the ancient Egyptians used it 4000 years ago, as they believed in its important role in treating heart and liver diseases. The scientific name of the *Cichorium* is Chicory (Cichorium intybus L.) is a part of the Asteraceae family (the tribe of Lactuceae)., so the current study aims to know the effect of biologically active substances in *Cichorium* on biochemical changes in obese rats. The experiment was performed in an animal house. All rats were separated into five groups, each with six rats, and given a baseline diet for one week before the trial. The first group sample of normal (n = 6) control negative (C-ve) rats were given solely the baseline diet for 28 days. The rest of the rats (n=24) were fed on a high-fat diet (20% animal fat) for obese rats. Experimental groups were fed varying concentrations of (5%, 10%, and 15% *Cichorium)*. As a result, rats fed on (5%) Cichorium powder recorded the highest glucose level with a significant difference (P<0.05) being, While, the lowest glucose level in obese rats recorded for (15%) Cichorium powder with significant differences (P<0.05). The highest serum albumin levels were recorded for the group fed on (10%) *Cichorium* powder and (5%) *Cichorium* powder. On the other hand, the lowest value was recorded for the group fed on (15%) *Cichorium* powder with a significant difference (P<0.05). The results suggested using *Cichorium* powder for obesity and hepatic patients.

Keywords: Cichorium, Active substances, Obese rats, Biological changes

Introduction

Obesity has many forms and degrees, and obesity associated with insulin resistance is one of the main risks. It is considered a risk factor for type 2 diabetes, and fat cells are the common link between obesity and diabetes because they play a vital role in energy balance. Jackson *et al.* (2017). *Cichorium* plant is considered one of the medicinal plants that have been known since ancient times, as the ancient Egyptians used it 4000 years ago, as they believed in its important role in treating heart and liver diseases. The scientific name of the *Cichorium* is Chicory (Cichorium intybus L.) is a part of the Asteraceae family (the Lactuceae tribe). Wang *et al*. (2019). Vitamins, caffeic acid derivatives, fructooligosaccharides, chlorogenic acid, magnolialide, polysaccharides, coumarins, phenolics, terpenoids, flavones, polyphenol, cichoriosides, ixerisosides, eudesmanolides, inulin, bitter sesquiterpene lactones, and alkaloids are some of the constituents of Cichorium. *Cichorium* has antioxidant, antibacterial, antipyretic, antidiabetic, antihepatotoxic. Satmbekova *et al.* (2018). Cichorium shows promise as a natural remedy for reducing oxidative stress and liver damage brought on by nitrosamine (sodium nitrite, 0.05% in DW) chemicals Lante *et al*. (2011).

Cichorium has beneficial effects by suppressing blood glucose accumulation and increasing lipid metabolism and antioxidant activities. In addition, the majority of the dietary fiber was water-insoluble. Hyperglycemia, dyslipidemia, and oxidative stress were all found to be improved by *Cichorium*. Furthermore, in rat adipocytes. Satmbekova *et al.* (2018). *Cichorium* has been shown to increase basal and insulin-stimulated glucose absorption. The major *Cichorium* catechin, (-)-Epigallocatechin Gallate (EGCG), has been shown to inhibit Sodium-dependent Glucose Transporter (SGLT1) intestinal glucose uptake, while it has been shown that EGCG and a catechin-rich green tea extract may imitate insulin by reducing the expression of genes that regulate gluconeogenesis Singh *et al*. (2010). In clinical practice, liver function tests (LFTs) are often used to detect liver disease, track the progression of a diagnosed illness, and assess the effects of drugs that can be hepatotoxic. *Cichorium* supplementation successfully warded off aberrant liver function, increased blood sugar, dyslipidemia, excess visceral and hepatic lipid buildup, and steatosis hepatitis. Bagherniya *et al.* (2018). The effects of *Cichorium* consumption on weight loss in laboratory animal studies. This antiobesity effect of *Cichorium* may be due to its ability to raise thermogenesis and lipid oxidation, lower lipid peroxidation as well as suppress appetite and nutrient absorption. Studies show that the advantages of *Cichorium* polyphenols include the effects on obesity and the related mechanism(s) that are not evident from its capacity to reduce persistent inflammation and oxidative stress damage and to improve antioxidant capabilities, Hassan and Yousef (2010).

Aim of Study

This research sought to determine the impact of biologically active substances in *Cichorium* on biochemical changes in obese rats

Materials and Methods

Materials

a. *Source of Cichorium:* Cichorium is obtained from the local market, Al-Baha City, KSA as dried material.

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b. *Experimental Animals:* 24 Sprague Dawley strain male albino rats weighing 150-10g each were utilized in the investigation.
c. *Cholesterol:* Animal lipid (20%) was used to induce obesity.
d. *Casein, Cellulose, Choline Chloride, and DL-Methionine:* From Morgan Co. Cairo, Egypt, we got casein, cellulose, choline chloride powder, and DL-methionine powder.
e. *Kits for Chemicals Used in this Research* (Bilirubin, urea, creatinine, TC, TG, HDL-c, ALT, AST, ALP, and albumin) were purchased from the Cairo, Egypt-based Al-Gomhoria Company for Chemical, Medical, and Instruments.

Methods

Analytical Methods

The Moisture was determined using an air oven at 100 - 102° C for about 3 h`ours. The total nitrogen was determined using Marco Kjeldahl methods, and crude protein was then calculated as T.N. X 6.25. Soxhlet equipment was employed to calculate the fat content. The extraction continued for 16 hours with n-hexane as the extraction solvent. Ash content was estimated after charring. The samples were placed in a muffle furnace at 525°C until white or light grey ash was collected, according to the method described by (AOAC, 2005).

Crude Fiber: Crude fiber was determined according to the (Pearson, 1971) method.

Carbohydrates Content: The variance was used to compute the carbohydrate as follows: % Carbohydrates = 100 - (% moisture + % protein + % fat + % ash + % fiber).

Determination of Total Flavonoids: To create the standard curve, catechin was employed (Liu *et al*., 2009).

Identification of Phenolic Compounds: An Agilent 1200 chromatograph outfitted with a PDA model G1315B, a Bin pump model G1312A, an auto-sampler model G1313A, and an RR Zorbax Eclipse Plus C18 column was used for the HPLC analysis of the tea sample (1.8 pm, 150 mm x4.6 mm).

Diets

Basal Diet: Protein (10%), corn oil (10%), choline chloride (0.2%), cellulose (5%), vitamin mixture (1%), Ain (1993), salt combination (4%), and corn starch (up to 100%) make up the basic diet. according to Ain, (1993)

The Induction of Experimental Obesity: Obesity was induced in normal healthy male albino rats by feeding on a high-fat diet (HFD) with 20% animal fat (cheap fat) supplemented in the basal diet and used as a positive control group.

Experimental Design: In this experiment, 30 mature male white albino Sprague Dawley strain rats weighed (140±10g), were 10 weeks old, and were white in color. All rats were fed on a basal diet. Ain (1993) for 7 consecutive days. After this adaptation period, rats are split into 5 groups, each group which consists of 6 rats as follows:

Group (1): Rats given a basic diet served as a negative control.

Group (2): Control-positive rats fed by high-fat diet (20% animal fat) supplemented in the basal diet and utilized as a positive control group.

Group (3): A group of obese rats fed on a basal diet.+ 5% *Cichorium*

Group (4): A group of obese rats fed on a basal diet.+ 10% *Cichorium*

Group (5): A group of obese rats fed on a basal diet.+ 15% *Cichorium*

During the experimental period, the body weight and feed intake were estimated weekly and the general behavior of rats was observed. The experiment will last for 28 days, after which each rat will be individually weighed before being killed and having blood samples taken. Blood samples were centrifuged at (4000 rpm) for ten minutes to separate blood serum, then kept in a deep freezer till use. Extracting the liver, spleen, kidney, and heart, the following tests were conducted for histological examinations.

Biological Evaluation

The following formulae were used to determine the body weight gain percentage (BWG) and food efficiency ratio (FIR) in line with (Chapman *et al*., 1959) to perform a biological assessment of the various diets:

$$BWG = \frac{Final\ weight - initial\ weight}{Initial\ weight} \quad (1)$$

$$FER = \frac{Gain\ in\ body\ weight\ (g)}{Feed\ intake\ (g)} \quad (2)$$

Organs Weight: Rat liver, kidney, heart, and other organs were delicately dissected, cleaned in saline solution, dried between two filter sheets, and then promptly preserved in buffered formalin solution (10%) for histological analysis.

Blood Sampling: Blood samples were taken after a 12-hour fast, first from the retroorbital vein, then after each trial, from the hepatic portal vein. According to the procedure outlined by (Schermer, 1967), blood samples were drawn into dry, clean centrifuge glass tubes, allowed to clot in a water bath (37°C) for 28 minutes, then centrifuged for 10 minutes at 4000 rpm to separate the serum. The serum was then carefully aspirated and transferred into a clean Eppendorf tube and stored frozen at -20°C until analysis.

Biochemical Analysis

Lipids Profile

Determination of Serum Total Cholesterol: Following (Thomas, 1992)'s colorimetric approach, the serum total cholesterol was measured.

Determination of Serum Triglycerides: The enzymatic technique of measuring serum triglycerides was carried out using kits consistent with (Young, 1975; Fossati, 1982).

Determination of High-Density Lipoprotein (HDL-c): HDL-c was measured using the approach outlined by (Fredewaid, 1972; Grodon & Amer, 1977).

Calculation of Very Low-Density Lipoprotein Cholesterol (VLDL-c): According to calculations made in mg/dl, VLDL-c was (Lee & Nieman, 1996).

Calculation of Low-Density Lipoprotein Cholesterol (LDL-c): LDL-c was estimated in mg/dl using (Lee & Nieman, 1996)

Calculation of Atherogenic Index (AI): Calculation of atherogenic index = (VLDL-C+ LDL-c) **(**Kikuchi-Hayakawa *et al*., 1998).

Liver Functions

Determination ALT: performed out using the (Clinica Chimica Acta, 1980) methodology

Determination Aminotransferase (AST) The technique of determining serum AST was used to determine (Hafkenscheid, 1979).

Determination of Serum Globulin: Serum globulin was measured using the technique outlined by (Henry, 1964).

Serum Albumin (SAlb): The technique outlined by (Doumas *et al*., 1971) was used to measure serum albumin.

Kidney Functions

Determination of Serum Urea: According to (Patton & Crouch, 1977), the enzymatic approach was used to determine the amount of urea.

Determination of Serum Creatinine: The procedure outlined by (Henry, 1974) was used to measure serum creatinine.

Determination of Serum Uric Acid: Using a calorimetric approach, serum uric acid was measured as stated by (Barham & Trinder, 1972).

Determination of Blood Glucose: The technique of (Tinder, 1969) was used for the calorimetric enzyme measurement of blood glucose.

Statistical Analysis

When a substantial main impact was found, the data were examined utilizing a fully randomized factorial design (SAS, 1988), and the means were separated employing the Student-Newman-Keuls test. Utilizing the Costat Program, variations between treatments that were ($P<0.05$) were deemed significant. One Way ANOVA was employed to assess biological data Snedecor and Cochran, (1967).

Results and Discussion

This research aims to comprehend the impact of the Anti-obesity effect of (*Cichorium*) in experimental rats.

Chemical Composition of Cichorium Powder

Data given in **Table 1** show the chemical composition of *Cichorium* powder. The outcomes revealed that the moisture, protein, fat, ash, fiber, carbohydrates, and energy value contents of *Cichorium* as dry weight (D/W) were 4.53, 17.95, 2.57, 5.97, 17.41, 51.57, and 319.33Kcal/100g, respectively. Various green tea samples had moisture, protein, fat, sugar, fiber, and ash contents of 2.2-5.0, 18.2-30.7, 3.5-5.3, 28.6-39.2, 10-19.5, and 5.4-7.4%, respectively,

Total Phenolics, Total Flavonoids, and Antioxidant Activity Content of Cichorium Powder: Data presented in **Table 1** show the total phenolics, total flavonoids, and antioxidant activity content of *Cichorium* powder.

It is clear to notice that the total phenolics, total flavonoids, and antioxidant activity content of *Cichorium* powder were 745.53 mg GAE/100 gm, 657.75 mg rutin/g DM, and 78.36 mg Trolox/100 gm., respectively (Nadiah & Uthumporn, 2015).

Table 1. Chemical composition and Total phenolics, total flavonoids, and antioxidant activity content of *Cichorium* powder

Constitutes (%)	Value D/W
Moisture	4.53±0.21
Protein	17.95±0.33
Fat	2.57±0.11
Ash	5.97±0.24
Fiber	17.41±0.31
Carbohydrates	51.57±0.50
Energy value (Kcal/lOOg)	319.33±0.63
Total phenolics (mg GAE/lOOg)	745.53
Total flavonoids (mg Rut. /100g)	657.75
DPPH(%)	78.36

DW= Dry weight, GAE= Gallic acid equivalent Rut. = Rutin. DPPH= 2.2 diphenyl picrylhydrazyl

GAE= Gallic acid equivalent Rut. = Rutin. DPPH= 2.2 diphenyl picrylhydrazyl

Biological Results

Data presented in **Table 2** and illustrated in show the influence of Cichorium powder on body weight gains(BWG), feed intake(FI), and feed efficacy ratio(FER) in obese rats.

The obtained findings demonstrated a substantial variation between the body weight gain (BWG) of the negative control and the positive control. The mean values were 31.0 and 19.00 g/28 days, respectively. From obese rat groups, it is clear to notice that the highest (BWG) was recorded for (2%) *Cichorium* powder, while the lowest BWG was recorded for (6%) *Cichorium* powder with a substantial variation ($P<0.05$). The median values were 26.7 and 19.80 g/ 28 days, respectively.

In the case of feed intake (FI), it was evident that the feed intake of negative control recorded a greater value when compared with positive control with a substantial variation. The mean values were 18.93 and 16.82 g/day, respectively.

From obese rat groups, it is obvious that the higher feed intake was recorded for (5%) *Cichorium* powder, while the lowest FI was recorded for (15%) *Cichorium* powder with a substantial variation ($P<0.05$). The median values were 19.50 and 18.50 g/day, respectively. The obtained results indicated that the higher feed efficiency ratio (FER) was recorded for the negative control group, while the lowest value was recorded for the positive control group

with a significant difference. The mean values were 0.058 and 0.040 %, respectively.

While, the largest feed efficiency ratio of the treated group was recorded for (5%) *Cichorium* powder, while the lowest FER was recorded for (15%) *Cichorium* powder with significant differences. The mean values were 0.049 and 0.038 g, respectively. These findings are in agreement with Hassan and Yousef (2010). The effects of *Cichorium* consumption on weight loss in laboratory animal studies. This antiobesity effect of *Cichorium* may be due to its ability to raise thermogenesis and lipid oxidation, lower lipid peroxidation as well as suppress appetite and nutrient absorption. Studies indicate that the positive effects of *Cichorium* polyphenols can be from its ability to suppress chronic inflammation and oxidative stress damage, and to rise antioxidant capacities, the effects on obesity along with the associated mechanisms(s) are not clear.

Table 2. Effect of different concentrations of *Cichorium* on BWG, FI, and FER of obese rats

Parameters Groups	Body weight gain (g) G /28 day	Feed intake (g/day) G/day	Feed Efficiency Ratio (%) G /28 day
G1 C (-)	31.0± 0.40^{a}	18.93± 0.40^{a}	0.058 ±0.05^{a}
G2 C (+)	19.00±0.20^{d}	16.82 ± 0.10^{b}	0.040+0.02^{b}
G3 Obese rats+5% *Cichorium*	26.7 ± 0.40^{b}	19.50±0.60^{a}	0.049 ±0.05^{a}
G4 Obese rats+10% *Cichorium*	22.30±0.30^{c}	19.36+0.50^{c}	0.041 ±0.03^{b}
G5 Obese rats+15% *Cichorium*	19.80± 0.10^{d}	18.50 ± 0.20^{a}	0.038 ±0.02^{b}
LSD (P<0.05)	1.092	1.162	0.007

BWG stands for body weight increase, FI for food intake, and FER for food efficiency ratio. Data are presented as mean SD. The average value for the same column with various letters is considerably different. (P<0.05).

Effect of Different Concentrations of (Cichorium powder) on Internal Organs Weight of Obese Rats

The effects of Cichorium powder on organ weight in obese rats are shown in the data in the **Table 3**. It is obvious to see that there was a substantial variation in the liver weight between the positive and negative control groups (P <0.05), with the liver weight of the negative control group recording a larger value. The median values were 6.80 and5.40 g, respectively. While, group rats fed on (15%) *Cichorium* powder recorded the highest liver weight, while the lowest value was recorded for (5%) *Cichorium* powder with no substantial variation (P<0.05). The values were 6.40 and 6.20 g, respectively. In contrast, the heart weights of the negative control group and the positive control group were substantially distinct (P <0.05), coming in at 0.52 and 0.30 g, respectively. While the group fed on (15%) *Cichorium* powder recorded the highest heart weight but the lowest value was recorded for (5%) *Cichorium* powder with no substantial variation (P<0.05). The median values were 0.49 and 0.40 g, respectively.

On the other hand, in kidney weight, the negative control group recorded a greater value when compared with the positive control group, which were 1.20 and 0.80 g, respectively. While the group fed on (15%) *Cichorium* powder recorded the highest kidney weight but the lowest value was recorded for (15%) *Cichorium* powder with no substantial variation (P<0.05). The median values were 1.20 and 0.90 g, respectively.

In the case of spleen weight, the negative control group recorded a greater value when compared with the positive control group, which were 0.90 and 0.57 g, respectively. While the group fed on (15%) *Cichorium* powder recorded the highest Spleen weight but the lowest value was recorded for (5%) *Cichorium* powder with no substantial variation (P<0.05). The median values were 0.87 and 0.74 g, respectively. These results are in agreement with Bahmani *et al*. (2015). The best that we can tell, this is the first study on the effects of *Cichorium* on the kidneys, liver, heart, lungs, and spleen members show that weight loss with an increase in kidney weight for positive control. These results were according to the study, and Parallel results were observed in patients.

Table 3. Effect of different concentrations of *Cichorium* on internal organs weight of obese rats

Parameters Groups	Liver (g)	Heart (g)	Kidney (g)	Spleen (g)
G1 C (-)	6.80^{a}± 0.40	0.52^{a} ± 0.40	1.20^{a}± 0.40	0.90^{a} ± 0.22
G2 C (+)	5.40^{b}±0.10	0.30^{b}± 0.10	0.80^{b}± 0.15	0.57^{b}± 0.11
G3 Obese rats+5% *Cichorium*	6.20^{a}± 0.40	0.40^{a}±0.30	0.90^{a}± 0.50	0.74^{a}± 0.23
G4 Obese rats+10% *Cichorium*	6.30^{a}± 0.20	0.46^{a}±0.31	1.10^{a}± 0.44	0.79^{a} ±0.50
G5 Obese rats+15% *Cichorium*	6.40^{a}± 0.50	0.49^{a}±0.40	1.20^{a}± 0.44	0.87^{a}±0.50
LSD (P<0.05)	1.032	0.551	0.652	0.414

Effect of Different Concentrations of Cichorium on Glucose Level of Obese Rats

Table 4 's data demonstrate Cichorium's impact on obese rats' blood glucose levels. The obtained findings showed a substantial variation (P <0.05) between the lower glucose value reported for the negative control group and the highest level recorded for the positive control group. The corresponding average values were 185.5 and 106.0 mg/dl. While, rats fed on (5%) *Cichorium* powder recorded the highest glucose level with a substantial variation (P<0.05) being, 158.0 mg/dl. While the lowest glucose level in obese rats was recorded for (15%) *Cichorium* powder with substantial variation (P<0.05). The value was 118.50 mg/dl. These findings are consistent with those reported by Satmbekova *et al.* (2018), who found that *Cichorium* can significantly lower blood glucose levels. These findings suggest that *Cichorium* has beneficial effects by suppressing blood glucose accumulation and

increasing lipid metabolism and antioxidant activities. In addition, the majority of the dietary fiber was water-insoluble. Hyperglycemia, dyslipidemia, and oxidative stress were all found to be improved by *Cichorium*. Furthermore, in rat adipocytes, *Cichorium*. has been shown to increase basal and insulin-stimulated glucose absorption. The major *Cichorium* catechin, (-)-Epigallocatechin Gallate (EGCG), has been shown to inhibit Sodium-dependent Glucose Transporter (SGLT1) intestinal glucose uptake, while it has been shown that EGCG and a catechin-rich green tea extract may imitate insulin by reducing the expression of genes that regulate gluconeogenesis Singh *et al*. (2010).

Table 4. Effect of different concentrations of *Cichorium* on glucose level in obese rats

Parameters Groups	Glucose (mg/dl)
G1 C (-)	$106.0^{C} \pm 0.10$
G2 C (+)	$185.50^{a} \pm 0.40$
G3 Obese rats+5% Cichorium	$158.0^{b} \pm 1.20$
G4 Obese rats+10% Cichorium	$140.10^{c} \pm 0.40$
G5 Obese rats+15% Cichorium	$118.50^{d} \pm 0.30$
LSD (P<0.05)	3.160

Effect of *Cichorium* Powder on Liver Function (ALT and AST) of Obese Rats.

Table 5's data demonstrate Cichorium's impact on the ALT and AST of obese rats. The acquired data demonstrated a substantial variation between the ASTs of the positive and negative controls, with the positive control recording the highest value. The median values were 88.54 and 38.98 U/L, respectively. From obese rat groups, it is clear to notice that the highest AST was recorded for (5%) *Cichorium*, while the lowest AST was recorded for (15%) *Cichorium* with a substantial variation (P<0.05). The median values were 69.32 and 46.14 U/L, respectively.

In the case of ALT, it could be noticed that the ALT of positive control recorded the highest value when compared with a negative control with a substantial variation. The mean values were 93.22 and 45.84 U/L, respectively. From obese rat groups, it is obvious that the highest ALT was recorded for (5%) *Cichorium*, while the lowest ALT was recorded for (15%) *Cichorium* with substantial variation (P<0.05). The median values were 78.24 and 54.96 U/L, respectively. According to Bagherniya *et al.* (2018), In clinical practice, liver function tests (LFTs) are often used to detect liver disease, track the progression of a diagnosed illness, and assess the effects of drugs that can be hepatotoxic. Supplementing with chromium successfully halted impaired liver function, high blood sugar, dyslipidemia, excessive visceral and hepatic lipid buildup, and steatosis hepatitis. A transaminase enzyme is called alanine transaminase (ALT). Although it may be detected in plasma and other human tissues, ALT is most often identified in the liver. The two steps of the alanine cycle are catalyzed by it. As indicators for liver health, serum ALT, AST, and their ratio (AST/ALT ratio) are often tested in clinical settings.

The outcomes showed a statistically substantial variation (P< 0.05) between the serum albumin levels of the positive control group and the negative control group, with the negative control group recording a higher value. The relative average values were 4.50 and 1.69 g/dl. The group fed on (10%) and (5%) Cichorium powder had the greatest serum albumin levels, however. On the other hand, a substantial variation (P< 0.05) was found between the lowest value reported for the group fed on Cichorium powder (15%). The relative median values were 3.00, 2.76, and 2.46 g/dl. Additionally, the data demonstrated a substantial (P<0.05) variation in the serum globulin levels of the positive and negative control groups, with the negative control group recording a higher value. 2.30 and 1.00 g/dl on average, respectively. While the group fed on (5%) Cichorium powder had the greatest blood globulin levels, the group fed on (10%) Cichorium had the lowest value, with a substantial variation (P<0.05). The corresponding median values were 1.60 and 1.10 g/dl. These outcomes are consistent with Ghaffari *et al*. (2019). showed that Total proteins produced by the liver are utilized as indicators of liver damage; an increase in these proteins is connected to the advancement of non-alcoholic liver pathologies such as fatty liver, which is linked to metabolic syndrome.

Albumin is the main component of total protein and is synthesized in the liver. The normal level of albumin in the blood ranges between 3.5 to 5.5 g per 100 ml of blood (35 to 55 g per liter of blood). The level of albumin in the blood increases in the following cases: Dehydration due to loss of fluids, such as what happens in continuous vomiting and severe diarrhea, nervous shock, increased blood concentration and injecting a large amount of albumin intravenously. The level of albumin in the blood decreases in the following cases: Nutrition or deficiency, malabsorption diseases acute and chronic kidney infections acute and chronic liver failure burn cases cardiomyopathy Katsiki *et al.* (2016).

Table 5. Effect of different concentrations of *Cichorium* on AST, ALT, serum albumin, and globulin of obese rats

Groups	(AST) U/L	(ALT) U/L	Serum albumin (g/dl)	Serum globulin (g/dl)
G1 C (-)	$38.98^{e} \pm 0.15$	$45.84^{c} \pm 0.14$	$4.50^{a} \pm 0.15$	$2.30^{a} \pm 0.14$
G2 C (+)	$88.54^{c} \pm 0.12$	$93.22^{c} \pm 0.10$	$1.69^{c} \pm 0.10$	$1.00^{c} \pm 0.11$
G3 Obese rats+5% Cichorium	$69.32^{b} \pm 0.16$	$78.24^{b} \pm 0.12$	$2.76^{b} \pm 0.13$	$1.60^{b} \pm 0.13$
G4 Obese rats+10% Cichorium	$54.66^{c} \pm 0.11$	$60.72^{c} \pm 0.15$	$3.00^{b} \pm 0.11$	$1.10^{c} \pm 0.14$
G5 Obese rats+15% Cichorium	$46.14^{d} \pm 0.10$	$54.96^{d} \pm 0.12$	$2.46^{c} \pm 0.13$	$1.20^{c} \pm 0.13$
LSD (P<0.05)	2.741	2.980	0.420	0.363

Effect of Cichorium on Total Cholesterol and Triglycerides Level and Lipid Profile of Obese Rats

The effect of *Cichorium* on the serum total cholesterol, triglycerides, and lipid profile of obese rats are shown in **Table 6**. The obtained results indicated that When compared to the negative control group, the total cholesterol values of the positive control

group had a higher value, which was significantly different (P <0.05). The relative median values were 137.00 and 92.50 mg/dl. While the group fed on (5%) Cichorium powder had the greatest cholesterol levels, the group fed on (15%) Cichorium powder had the lowest value, with a substantial variation (P<0.05). The corresponding median values were 113.50 and 95.70 mg/dl.

However, the triglycerides of the positive control group were greater than those of the negative control group, with a substantial variation (P<0.05) between the two groups. The corresponding median values were 145.20 and 69.90 mg/dl. While the group fed on (5%) Cichorium powder had the greatest triglyceride, the group fed on (15%) Cichorium powder had the lowest value, with a substantial variation (P<0.05). The corresponding median values were 95.60 and 73.30 mg/dl.

Cichorium administration dramatically reduced triglyceride and total cholesterol levels in rats, according to Basu *et al*. (2011). Several other research, on the other hand, found no link between green tea consumption and lower TC and LDL cholesterol. *Cichorium* supplementation effectively reduced hyperlipidemia status in high-fat diet produced rats, including reducing TC, LDL cholesterol, and triglycerides, according to Ratziu *et al.* (2019), The high concentration of *Cichorium*, which plays a vital role as a potent antioxidant, maybe the mechanism underpinning *Cichorium* favorable effect on lipid management.

The obtained results indicated that the high-density lipoprotein (HDL-c) levels of the negative control group recorded a higher value when compared with a positive control group with a substantial variation (P<0.05). 48.05 and 29.50 mg/dl on average, respectively. While the group fed on 15% Cichorium powder had the highest (HDL-c) values, the group fed on 5% Cichorium powder had the lowest value, with a substantial variation (P <0.05). The corresponding median values were 44.50 and 40.61 mg/dl.. As specified by the data, the positive control group's low-density lipoprotein (LDL-c) values were greater than those of the negative control group, with a substantial variation (P<0.05). The corresponding median values were 78.46 and 30.47 mg/dl. While the group fed on (5%) Cichorium powder had the highest (LDL-c) values, the group fed on (15%) Cichorium powder had the lowest value, with a substantial variation (P<0.05). 53.77 and 36.54 mg/dl, respectively, were the means.

Very low-density lipoprotein (VLDL-c) levels showed a substantial variation (P<0.05) between the positive control group and the negative control group, with the positive control group recording a greater value. 29.04 and 13.98 mg/dl, respectively, were the average values. While the group fed on (5%) Cichorium powder had the highest (VLDL-c) values, the group fed on (15%) Cichorium powder had the lowest value, with a substantial variation (P<0.05). 19.12 and 14.66 mg/dl on average, respectively. These findings correspond with that of HDL is a derivative of lipoproteins and is called Also, alpha lipoprotein contains 25 to 45% of cholesterol plus HDL phospholipids carry cholesterol from the blood to the liver where it is extracted from the bile. This means that an increase in the level of HDL in the blood leads to a decrease in the level of cholesterol in the blood, which prevents the occurrence of atherosclerosis, which is sometimes called good or good cholesterol Jurgonski *et al.* (2012).

Table 6. Effect of different concentrations of matcha *Cichorium* tea on scrum triglycerides (T.G), serum total cholesterol (TC), and lipid profile of obese rats

Groups	Total cholesterol (TC)	Triglycerides (TG) mg/dl	(HDL-c) (mg/dl)	(LDL-c) (mg/dl)	Lipoprotein (VLDL-c) (mg/dl)
G1 C (-)	92.50^{e}±0.15	69.90^{e}±0.11	48.05^{a} ± 2.80	30.47^{e}± 0.13	13.98^{d}± 0.69
G2 C (+)	137.00^{a}±0.11	145.20^{a}±0.15	29.50^{e}± 1.71	78.46^{a}± 1.58	29.04^{a}± 1.20
G3 Obese rats+5% Cichorium	113.50^{b}±0.13	95.60^{b}±0.11	40.61^{d}±0.50	53.77^{b}± 1.91	19.12^{b} ± 1.72
G4 Obese rats+10% Cichorium	99.80^{c} ±0.14	81.00^{c}±0.12	42.46^{b}±1.38	41.14^{c}±0.33	16.20^{c} ±0.10
G5 Obese rats+15% Cichorium	95.70^{d}±0.12	73.30^{d}±0.10	44.50^{b}±1.10	36.54^{d}±l .10	14.66^{c}±2.20
LSD (P<0.05)	3.130	3.641	3.010	2.110	3.010

TG= Triglycerid TC=Total Cholesterol

Effect of Different Concentrations of Cichorium on Kidney Functions of Obese Rats

Data presented in **Table 7** show the effect of different concentrations of *Cichorium* on kidney functions (urea, uric acid, and creatinine) of obese rats.

It is evident that, with a substantial variation (P <0.05), the urea levels of the positive control group recorded a higher value than those of the negative control group. The corresponding mean readings were 68.05 and 37.00 mg/dl. While the group fed on Cichorium powder (5%) had the highest urea levels, the group fed on Cichorium powder (15%) had the lowest values, with a substantial variation (P <0.05). 54.81 and 41.10 mg/dl, respectively, were the means.

The findings also showed a statistically substantial variation (P <0.05) between the uric acid values of the positive control group and the negative control group, with the positive control group recording a greater value. 3.27 and 1.41 mg/dl on average, respectively. While the group fed on (5%) Cichorium powder had the greatest uric acid values, the group fed on (15%) Cichorium powder had the lowest levels, with a substantial variation (P<0.05). 2.21 and 1.25 mg/dl on average, respectively.

When it came to creatinine levels, data revealed that there was a substantial variation between the positive control group's higher value and the negative control group's lower value (P< 0.05). The relative median values were 4.80 and 1.52 mg/dl. While the highest creatinine levels were recorded for the group fed on (5%) *Cichorium* powder, the lowest value was recorded for the group fed on (15%) *Cichorium* powder with substantial variation

(P<0.05). The median values are 3.49 and 2.45 mg/dl, respectively. These findings are consistent with those of Cho *et al.* (2010), who found that *Cichorium* therapy dramatically reduced kidney AGE levels and serum thiobarbituric acid-reactive compounds. Cichorium supplementation also resulted in lower levels of renal CML, CEL, and RAGE expression, as well as a rise in hepatic SREBP-2 expression, but not SREBP-1. These results show that Cichorium acts as an antioxidant, lowers hepatic glucose, triglyceride, and total cholesterol levels, and inhibits the accumulation of AGE in the kidneys to prevent hepatic and renal damage.

Table 7. Effect of different concentrations of *Cichorium* on kidney functions of obese rats

Groups	Urea (mg/dl)	Uric acid (mg/dl)	Creatinine (mg/dl)
G1 C (-)	37.00^{d}± 1.10	1.41^{b}± 0.10	1.52^{c}±0.10
G2 C (+)	68.05^{a}±2.20	3.27^{a}± 0.20	4.80^{a}±0.60
G3 Obese rats+5% Cichorium	$54.8\ l^{b}$± 1.20	2.21^{b}± 0.30	3.49^{b}±0.30
G4 Obese rats+10% Cichorium	43.40^{c}± 0.80	1.30^{b}± 1.20	2.77^{b}±0.11
G5 Obese rats+15% Cichorium	41.10^{b} ± 0.70	1.25^{b}± 1.10	2.45^{b}±0.20
LSD (P<0.05)	3.201	1.003	1.102

Conclusion

The results showed that the Cichoriumhad an effective effect on reducing wight and improving the biolgical functions of obes rats and the improvement rate increased in the group containing 5% Cichorium, bec.

Recommendations

1. For people with obesity and high cholesterol, chromium powder is advised.
2. Cichorium powder in various concentrations may be recommended for reducing LDL and atherogenic index values.

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