Anti-obesity Effect of Asparagus and Broccoli in Induced Rats

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Abstract

The effect of different concentrations (5&10%) as powder of asparagus stem and broccoli floret on obese rats was evaluated. Eighty four male albino rats weighting 140 ±10 g were used in this study and divided into 8 groups, each group contain 6 rats. Rats were treated by high fat diet (20% animal fat) to induce obese. Results showed that the highest body weight gain, feed intake and feed efficiency ratio recorded for 10 mixture vegetables, 5 % asparagus stem and 10 % broccoli floret, respectively with significant difference. The lower ALT, AST and ALP liver enzyme of treated group recorded for group fed on 10% mixture with significant differences. The lowest cholesterol and triglycerides levels recorded for 10 % mixture with no significant differences. The highest (HDL-c) levels recorded for group fed on 10% mixture. The lowest LDL-c and VLDL-c values recorded for group fed on 10 % mixture with significant difference. While, the lowest uric acid, urea and creatinine values recorded for group fed on 10 % mixture with significant difference. As conclusion, obese rats treated with 10 % mixture had improvement lipid profile, liver and kidney functions compared with gooseberry fruit powder.

Key words:

Asparagus, Broccoli, Rats, Anti-obesity and Biochemical analysis.

INTRODUCTION

Obesity is the most prevalent health problem. It is also known to be a risk factor for the development of metabolic disorders such a s type 2 diabetes, systemic hypertension, cardiovascular disease, dyslipidemia, and atherosclerosis. Obesity is a pathological condition in which excess body fat has accumulated to the extent that it may have an adverse effect on health, leading to reduced life expectancy and/or increased health problems (**Cheng *et al*., 2010).**

Hassan and El-Gharib, (2015) concluded that obesity is becoming one of the most prevalent health concerns among all populations and age groups worldwide, resulting in a significant increase in mortality and morbidity related to coronary heart diseases, diabetes type 2, metabolic syndrome, stroke, and cancers. Disappointing results after cessation the lifestyle modification or pharmacotherapy compelled the researchers and physicians to rethink to find a new, safe, and striking therapeutic alternative for this global health concern. Many natural products act as anti-obesity through various mechanisms to reduce body weight and its complications.

Also, obesity is generally defined as the abnormal or excessive accumulation of fat in adipose tissue to the extent that health may be impaired (**Aronne and Segal, 2002).**

The Asparagus officinalis is an herbaceous, perennial plant belongs to family Asparagaceae which has 150 species broadly dispersed in tropical and sub-tropical regions up to 1500 m elevation and very dominant in regions of southern Africa, Europe, Australia and Asia. There are about 14 diverse species of Asparagus are present in Pakistan. This specie is extraordinarily valuable as because of its use for ornamental, vegetable and medicinal purpose from prehistoric time (**Velavan *et al*., 2007**).

Asparagus officinalis, (L.) is considered as a high value plant because of its therapeutic and neutraceutical characteristics. Its constituent saponins and fructans play pivotal role in anti-tumor activity and reduction of the risk of disorders such as constipation, diarrhea as well as diseases like osteoporosis, obesity, cardiovascular disease, rheumatism and diabetes (Sharma et al., 2000).

Zhu *et al*., (2011) reported that Asparagus significantly decreased the levels of body weight gain, serum total cholesterol and low density lipoprotein cholesterol; it dramatically increased the high density lipoprotein level when administered at three different doses (40, 80 or

160 mg/kg body weight) for 8 weeks in hyperlipidemic mice. In addition, asparagus butanol extract decreased the levels of alanine transaminase, aspartate in mice.

The broccoli is a vegetable that belongs to family Cruciferae and genus Brassica; this genus also includes commercially important crops such as cauliflower and cabbage. The main edible parts of broccoli are edible sprouts and florets named the inflorescence **(Olga *et al*., 2009).**

Broccoli is known as "crown jewel of nutrition“ the nutrients namely vitamins, minerals, secondary metabolites and fiber proclaiming its exceptional health benefits. The breakdown products of the sulfur containing glucosinolates, isothiocyanates are the active principles in exhibiting the anticancer property at every stage (**Hannah *et al*., 2009).**

Broccoli is a good source of sulforaphane which was used as a functional food in a study wherein the rat model showed that broccoli decreased hepatic triglyceride **(Chen *et al*., 2016).**

In a different study, broccoli powder was used as a supplementary treatment in a randomized double-blind placebo-controlled clinical trial and the improvement of serum triglyceride and oxidized LDL/LDL-cholesterol ratio were investigated **(Bahadoran *et al*., 2012).**

While in a separate clinical study of 12 subjects, it was demonstrated that the consumption of broccoli for only 1 week, reduced markers of oxidative stress along with increased metabolism of cholesterol (Murashima et al., 2004).

Kuerban *et al*., (2017) reported that broccoli vegetables are rich in bioactive phytochemicals and can be used as an alternative dietary supplement for anti-obesity purposes. However, the bioavailability and absorption of the nutrients depend upon the method employed for processing before consumption, as over boiling or overcooking render the phytochemicals inactive.

This work was conducted to study the effect of different concentration of asparagus and broccoli as powder on biochemical analysis of obese rats.

Material and Methods

Materials:

Asparagus (Asparagus officinalis, L.) stem and broccoli (Brassica oleracea) floret vegetables were obtained from local market, Cairo City, Cairo Governorate, Egypt.

The induction of experimental obesity

Obesity was induces in normal healthy male albino rats by fed on high fat diet (20% animal lipid) supplemented in the basal diet and used as a positive control group.

Casein, cellulose, choline chloride, and DL- Methionine

Casein, cellulose, choline chloride powder, and DL- methionine powder, were obtained from Morgan Co. Cairo, Egypt.

Experimental animals

A total of 48 adult normal male albino rats Sprague Dawley strain weighing 140±10 g were obtained from Vaccine and Immunity Organization, Ministry of Health, Helwan Farm, Cairo, Egypt.

The chemical kits

Chemical kits used for determination the (TC, TG, HDL-c, ALT, AST, ALP, urea, uric acid and creatinine) were obtained from Al-Gomhoria Company for Chemical, Medical and Instruments, Cairo, Egypt.

Methods

Preparations of vegetables

To prepare the dried asparagus stem and broccoli floret were obtained from local market. Fruits were washed thoroughly under running tap water, shade dried, and ground to a fine powder using an air mill.

Experimental design

Thirty six adult male white albino rats, Sprague Dawley Strain, 10 weeks age, weighing (140±10g) were used in this experiment. All rats were fed on basal diet (casein diet) prepared according to **AIN, (1993)** for 7 consecutive days. After this adaptation period, rats are divided into 8 groups, each group which consists of six rats as follows: group (I): rats fed on basal diet as negative control. Group (2): Obese rats induced by fed on high fat diet (20% animal lipid) supplemented in the basal diet and used as a positive control group. Group (3): A group obese rats fed on asparagus stem as powder by 5% of the weight of basal diet. Group (4): A group infected obese rats fed on asparagus stem as powder by 10% of basal diet. Group (5): A group infected obese rats fed on broccoli floret as powder by 5% of the weight of basal diet. Group (6): A group infected obese rats fed on broccoli floret as powder by 5% of the weight of basal diet. Group (7): A group infected obese rats fed on mixture of asparagus stem and broccoli floret as powder by 5% of the weight of basal diet. Group (8): A group infected obese rats fed on mixture of asparagus stem and broccoli floret as powder by 10% of the weight of basal diet. During the experimental period, the body weight and feed intake were estimated weekly and the general behavior of rats was observed. The experiment period was take 28 days, at the end of the experimental period each rat weight separately then, rats are slaughtered and collect blood samples. Blood samples were centrifuged at 4000 rpm for ten minute to separate blood serum, and then kept in deep freezer till using.

Blood sampling:

After fasting for 12 hours, blood samples in initial times were obtained from retro orbital vein, while it obtained from hepatic portal vein at the end of each experiment. Blood samples were collected into a dry clean centrifuge glass tubes and left to clot in water bath (37°C) for 30 minutes, then centrifuged for 10 minutes at 4000 rpm to separate the serum, which were carefully aspirated and transferred into clean cuvette tube and stored frozen in deep freezer till analysis according to method described by Schermer (1967).

Body weight gain (BWG), feed intake (FI), and feed efficiency ratio (FER):

During the experimental period (28 days) the net feed intake was daily recorded, while body weight was weekly recorded. The net feed intake and gained body weight were used for the calculation of feed efficiency ratios (FER) according to **Chapman *et al*., (1959)** as follow:

$$\text{FER \%} = \frac{\text{Body weight gain (g)}}{\text{Food intake (g)}} \times 100$$

Biochemical analysis:

Lipids profile:

Determination of total cholesterol:

Serum total cholesterol was determined according to the colorimetric method described by **Thomas (1992)**.

Determination of serum triglycerides:

Serum triglyceride was determined by enzymatic method using kits according to the Young, (1975) and Fossati, (1982).

Determination of high density lipoprotein (HDL-c):

HDL-c was determined according to the method described by **Friedewaid (1972)** and **Grodon and Amer (1977).**

Calculation of very low density lipoprotein cholesterol (VLDL-c):

VLDL-c was calculated in mg/dl and of low density lipoprotein cholesterol (LDL-c): according to Lee and Nieman (1996) using the following formula:

VLDL-c (mg/dl) = Triglycerides / 5

Calculation of low density lipoprotein cholesterol (LDL-c):

LDL-c was calculated in mg/dl according to Lee and Nieman (LDL-c (mg/dl) = Total cholesterol – HDL-c – VLDL-c

Liver functions

Determination of serum alanine amino transferase (ALT), serum asparatate amino transferase (AST), serum alkaline phosphatase (ALP) were carried out according to the method of **Hafkenscheid (1979) , Clinica Chimica Acta (1980),** and **Moss (1982),** respectively.

Kidney functions

Determination of serum urea

Serum urea and serum creatinin were determinated by enzymatic method according to **(Henry (1974)** and **Patton & Crouch 1977).**

Statistical analysis:

The data were analyzed using a completely randomized factorial design **(SAS, 1988)** when a significant main effect was detected; the means were separated with the Student-Newman-Keuls Test. Differences between treatments of ($P \leq 0.05$) were considered significant using Costat Program. Biological results were analyzed by One Way ANOVA.

RESULTS AND DISCUSSION

1. Effect of asparagus and broccoli powder on body weight gain (BWG), feed intake (FI) and feed efficiency ratio (FER) of obese rats

Data presented in Table (1) show the effect of asparagus stem and broccoli floret on body weight gain, (BWG), feed intake (FI) and feed efficiency ratio (FER) of obese rats are shown in Table (9) and illustrated in Figs. (13-15). It is clear to notice that the highest body weight gain (BWG) recorded for negative control group, while positive control group recorded the lowest value with significant differences. The mean values were 58.21 and 22.10 g, respectively. On the other hand, the highest body weight gain of treated groups (obese groups) recorded for 10 % mixture, while the lowest value recorded for 10% broccoli floret with significant differences. The mean values were 50.25 and 41.35 g, respectively. In case of feed intake (FI), it could be concluded that the highest feed intake recorded for negative control group, while positive control group recorded the lowest value with significant differences. The mean values were 26.75 and 18.45 g, respectively. On the other hand, the highest feed intake of treated groups (obese groups) recorded for 5 % asparagus stem, while the lowest value recorded for 10% broccoli floret with significant differences. The mean values were 25.18 and 20.15 g, respectively. In case of feed efficiency ratio (FER), it could be noticed that the highest feed efficiency ratio recorded for negative control group, while positive control group recorded the lowest value with significant differences. The mean values were 0.078 and 0.043 %, respectively. On the other hand, the highest feed efficiency ratio of treated groups (obese groups) recorded for 10 % broccoli floret, while the lowest value recorded for 5% broccoli floret with significant differences. The mean values were 0.073 and 0.064 %, respectively. These results are in agreement with **Fuentes-Alventosa *et al* (2009),** they reported that a feed intake reduction in the group of animals treated with the higher asparagus dose. This finding could be attributed to the high-fiber content of this vegetable.

2. Effect of asparagus stem and broccoli floret as powders on liver functions levels of obese rats

Data given in Table (2) show the effect of asparagus stem and broccoli floret as powders on liver functions levels (ALT, AST and ALP) of obese rats. It is clear to mention that the highest ALT liver enzyme levels recorded for positive control group, while negative control group recorded the lowest value with significant differences. The mean values were 69.40 and 22.20 U/L, respectively. On the other hand, the highest ALT liver enzyme of treated groups (obese groups) recorded for 10 % broccoli floret, while the lowest value recorded for 10% mixture with significant differences. The mean values were 61.40 and 27.90 U/L, respectively. In case of AST liver enzyme, the highest levels recorded for positive control group, while negative control group recorded the lowest value with significant differences. The mean values were 70.60 and 24.27 U/L, respectively. On the other hand, the highest AST liver enzyme of treated groups (obese groups) recorded for 10 % broccoli floret, while the lowest value recorded for 10% mixture with significant differences. The mean values were 63.00 and 37.80 U/L, respectively. In case of ALP liver enzyme, the highest levels recorded for positive control group, while negative control group recorded the lowest value with significant differences. The mean values were 87.56 and 67.10 U/L, respectively. On the other hand, the highest ALP liver enzyme of treated groups (obese groups) recorded for 10 % broccoli floret, while the lowest value recorded for 10% mixture with significant differences. The mean values were 82.20 and 69.11 U/L, respectively. These results are in agreement with **Venkatesan *et al*., (2003),** they reported that diet supplementation with “triguero” asparagus is able to prevent atherogenic risk markers as well as to prevent the oxidative hepatic damage in hypercholesterolemic conditions. Likely, functional components present in this asparagus variety, as flavonoids and steroidal saponins, could be responsible, at least in part, for this protective effect.

3. Effect of asparagus stem and broccoli floret as powders on total cholesterol and serum triglycerides levels of obese rats

Data presented in Table (3) show the effects of asparagus stem and broccoli floret as powders on serum total cholesterol and serum triglycerides levels of obese rats. The obtained results indicated that the highest serum total cholesterol levels recorded for positive control group, while negative control group recorded the lowest value with significant differences. The mean values were 237.60 and 119.80 mg/dl, respectively. On the other hand, the highest serum total cholesterol levels of treated groups (obese groups) recorded for 10% broccoli floret, while the lowest value recorded for 10 % mixture with no significant differences. The mean values were 195.40 and 135.10 mg/dl, respectively. In case of serum triglycerides levels, it could be concluded that the highest serum total cholesterol levels recorded for positive control group, while negative control group recorded the lowest value with significant differences. The mean values were 210.20 and 103.80 mg/dl, respectively. On the other hand, the highest serum triglycerides levels of treated groups (obese groups) recorded for 10% broccoli floret, while the lowest value recorded for 10 % asparagus stem with significant differences. The mean values were 173.0 and 117.60 mg/dl, respectively. These results are in agreement with Torres-Duran et al., (1998) they reported that levels of TG and TC in the liver also have been estimated to explain the status of liver. High level of TG and TC in the liver is the indication of the liver injury.

4. Effect of asparagus stem and broccoli floret powder on serum lipid profile of obese rats:

Data presented in Table (15) show the effects of asparagus stem and broccoli floret on high density lipoprotein cholesterol (HDL-C), low density lipoprotein cholesterol (LDL-C) and very low density lipoprotein cholesterol (VLDL-C), levels of obese rats. The obtained results indicated that the highest high density lipoprotein cholesterol levels recorded for negative control group, while positive control group recorded the lowest value with significant differences. The mean values were 41.00 and 28.00 mg/dl, respectively. On the other hand, the highest high density lipoprotein cholesterol levels of treated groups (obese groups) recorded for 10% mixture, while the lowest value recorded for 10% broccoli floret with significant differences. The mean values were 38.40 and 31.80 mg/dl, respectively. Data also indicated that the highest low density lipoprotein cholesterol levels recorded for positive control group, while negative control group recorded the lowest value with significant differences. The mean values were 167.56 and 58.10 mg/dl, respectively. On the other hand, the highest low density lipoprotein cholesterol levels of treated groups (obese groups) recorded for 10% broccoli floret, while the lowest value recorded for 10 % mixture with significant differences. The mean values were 129.00and 73.88 mg/dl, respectively. In case of very low density lipoprotein cholesterol levels, it could be concluded that the highest VLDL-c levels recorded for positive control group, while negative control group recorded the lowest value with significant differences. The mean values were 42.04 and 20.76 mg/dl, respectively. On the other hand, the highest low density lipoprotein cholesterol (VLDL-c) levels of treated groups (obese groups) recorded for 10% broccoli floret, while the lowest value recorded for 10 % mixture with significant differences. The mean values were 34.60 and 23.82 mg/dl, respectively. These results are in agreement with Garcia et al., (2012), they reported that the after treatment with FA for a period of 5 weeks, a significant decrease in plasmatic TC accompanied by a reduction in its

LDL-c fraction was observed in hyperlipidemic rats. FA also showed a beneficial effect, causing a weak increase in HDL-c level, although the differences were not statistically significant. Also, showed that the intake of green asparagus helps to regulate plasma lipid levels and prevents oxidative damage in hypercholesterolemic conditions.

5. Effect of asparagus stem and broccoli floret as powders on kidney functions (urea, uric acid and creatinine) levels of obese rats:

Data given in Table (5) show the effects of asparagus stem and broccoli floret as powders on kidney functions (serum urea, serum uric acid and serum creatinine), levels of obese rats. The obtained results indicated that the highest serum urea levels recorded for negative control group, while positive control group recorded the lowest value with significant differences. The mean values were 36.40 and 19.00 mg/dl, respectively. On the other hand, the highest serum urea levels of treated groups (obese groups) recorded for 10% broccoli floret, while the lowest value recorded for 10 % mixture with significant differences. The mean values were 33.60 and 20.70 mg/dl, respectively. The obtained results showed that the highest serum uric acid levels recorded for positive control group, while negative control group recorded the lowest value with significant differences. The mean values were 3.80 and 2.12 mg/dl, respectively. On the other hand, the highest serum uric acid levels of treated groups (obese groups) recorded for 10% broccoli floret, while the lowest value recorded for 10 % mixture with significant differences. The mean values were 3.58 and 2.38 mg/dl, respectively. The obtained results showed that the highest serum creatinine levels recorded for positive control group, while negative control group recorded the lowest value with significant differences. The mean values were 1.01 and 0.68 mg/dl, respectively. On the other hand, the highest serum creatinine levels of treated groups (obese groups) recorded for 10% broccoli floret, while the lowest value recorded for 10 % mixture with significant differences. The mean values were 0.97 and 0.67 mg/dl, respectively. These results are in agreements with **Dulak *et al*., (2000),** they reported that proved the role of nitric oxide in induction of synthesis of vascular endothelial growth factor by rat vascular smooth muscle cells. Lesions in liver and kidney was greatly alleviated in cauliflower and broccoli fed group that was related to partially to alleviation in vascular changes and improvement of biochemical profiles that observed in cauliflower and broccoli fed groups.

Table (1): Effect of asparagus and broccoli powder on body weight gain (BWG), feed intake (FI) and feed efficiency ratio (FER) of obese rats:

Groups	Parameters		
	BWG (g)	FI (g/day)	FER (g/day)
	Mean±SD	Mean±SD	Mean±SD
Group1(negative control)	$58.21^{a}\pm0.32$	26.75 ± 1.23^{a}	$0.078^{a}\pm0.004$
Group 2 (positive control)	$22.10^{e}\pm0.20$	18.45 ± 1.24^{d}	$0.043^{e}\pm0.002$
Group3 (5% asparagus)	$49.40^{b}\pm0.11$	25.18 ± 1.10^{a}	$0.070^{c}\pm0.001$
Group 4 (10% asparagus)	$46.65^{c}\pm0.50$	24.27 ± 1.25^{b}	$0.069^{c}\pm0.002$
Group 5 (5% broccoli)	$42.62^{d}\pm0.61$	23.70 ± 1.12^{b}	$0.064^{d}\pm0.003$
Group 6 (10% broccoli)	$41.35^{d}\pm0.12$	20.15 ± 1.31^{c}	$0.073^{b}\pm0.005$
Group 7 (5% mixture)	$44.37^{c}\pm0.12$	24.27 ± 1.25^{b}	$0.065^{d}\pm0.003$
Group 8 (10% mixture)	$50.25^{b}\pm0.61$	25.15 ± 1.23^{a}	$0.071^{c}\pm0.005$
LSD	2.54	1.80	0.0023

Each value is represented as mean ± standard deviation (n = 3).

Mean under the same column bearing different superscript letters are different significantly ($P \leq 0.05$).

Table (2): Effect of asparagus and broccoli powder on liver functions (ALT, AST and ALP) of obese rats

Groups	Parameters		
	ALT(U/L)	AST(U/L)	ALP(U/L)
	Mean ±SD	Mean ±SD	Mean ±SD
Group1(negative control)	22.20 ± 1.48^{f}	24.27 ± 1.64^{f}	67.10 ± 2.00^{e}
Group 2(positive control)	69.40 ± 2.40^{a}	70.60 ± 2.40^{a}	87.56 ± 2.23^{a}
Group3 (5% asparagus)	42.60 ± 3.57^{d}	52.00 ± 5.70^{d}	76.00 ± 2.54^{c}
Group4 (10% asparagus)	29.40 ± 3.71^{e}	39.60 ± 2.50^{e}	71.04 ± 1.58^{d}
Group 5 (5% broccoli)	53.80 ± 4.60^{c}	58.00 ± 2.12^{b}	80.85 ± 2.44^{b}
Group 6 (10% broccoli)	61.40 ± 2.96^{b}	63.00 ± 2.44^{b}	82.20 ± 3.42^{b}
Group 7 (5% mixture)	40.90 ± 1.04^{d}	50.80 ± 1.30^{d}	74.00 ± 1.14^{c}
Group 8 (10% mixture)	27.90 ± 2.50^{e}	37.80 ± 2.20^{e}	69.11 ± 1.31^{de}
LSD	3.57	4.10	2.28

Each value is represented as mean ± standard deviation (n = 3).

Mean under the same column bearing different superscript letters are different significantly ($P \leq 0.05$).

Table (3): Effect of asparagus stem and broccoli floret powder on total cholesterol and triglyceride of obese rats

Groups	Parameters	
	Total cholesterol (mg/dl)	Triglycerides (mg/dl)
	Mean ±SD	Mean ±SD
Group1 (negative control)	119.80±2.94^{f}	103.80±4.65^{f}
Group 2 (positive control)	237.60±16.63^{a}	210.20±4.60^{a}
Group3 (5% asparagus)	154.40±5.85^{d}	123.00±5.24^{d}
Group4 (10% asparagus)	138.40±4.15^{e}	117.60±2.07^{e}
Group 5 (5% broccoli)	178.80±3.70^{c}	140.20±4.60^{c}
Group 6 (10% broccoli)	195.40±4.92^{b}	173.00±13.22^{b}
Group 7 (5% mixture)	150.60±5.85^{d}	120.50±5.24^{e}
Group 8 (10% mixture)	135.10±2.10^{e}	119.10±2.03^{e}
LSD	3.98	2.75

Each value is represented as mean ± standard deviation (n = 3).
Mean under the same column bearing different superscript letters are different significantly (p≤0.05).

Table (4): Effect of asparagus and broccoli as powders on lipid profile of obese rats

Groups	Parameters		
	HDL-c (mg/dl)	LDL-c (mg/dl)	VLDL-c (mg/dl)
	Mean ± SD	Mean ± SD	Mean ± SD
Group1(negative control)	41.00±2.23^{a}	58.10±4.51^{f}	20.76±0.93^{e}
Group 2(positive control)	28.00±2.12^{d}	167.56±3.35^{a}	42.04±0.92^{a}
Group3 (5% asparagus)	33.80±2.34^{c}	96.00±2.28^{d}	24.60±1.04^{d}
Group4 (10% asparagus)	37.4±2.40^{b}	77.48±3.87^{e}	23.52±0.41^{d}
Group 5 (5% broccoli)	33.20±1.92^{c}	117.56±3.39^{c}	28.04±0.92^{c}
Group 6 (10% broccoli)	31.80±3.83^{c}	129.00±5.17^{b}	34.60±2.64^{b}
Group 7 (5% mixture)	33.91±2.95^{c}	92.70±2.16^{d}	24.10±0.20^{d}
Group 8 (10% mixture)	38.40±2.51^{b}	73.88±4.25^{e}	23.82±0.35^{d}
LSD	3.16	3.89	1.92

Each value is represented as mean ± standard deviation (n = 3).

HDL-C= High density lipoprotein cholesterol. LDL =Low density lipoprotein cholesterol

VLDL = Very low density lipoprotein cholesterol

Mean under the same column bearing different superscript letters are different significantly(p≤ 0.05).

Table (5): Effect of asparagus and broccoli powder on kidney functions on (serum urea, creatinine and uric acid) of obese rats

Groups	Parameters		
	Urea (mg/dl)	Uric acid (mg/dl)	Creatinine (mg/dl)
	Mean ± SD	Mean ± SD	Mean ± SD
Group1(negative control)	19.0±1.58[f]	2.12±0.83[f]	0.68±0.04[d]
Group 2 (positive control)	36.40±2.07[a]	3.80±0.15[a]	1.01±0.13[f]
Group3 (5% asparagus)	27.20±2.77[d]	2.86±0.114[d]	0.81±0.081[a]
Group4 (10% asparagus)	22.20±3.03[e]	2.50±0.158[e]	0.75±0.10[d]
Group 5 (5% broccoli)	30.80±1.48[c]	3.30±0.20[c]	0.91±0.03[c]
Group 6 (10% broccoli)	33.60±3.04[b]	3.58±0.083[b]	0.97±0.07[b]
Group 7 (5% mixture)	25.70±3.51[d]	2.69±0.147[d]	0.80±0.050[d]
Group 8 (10% mixture)	20.70±1.12[e]	2.38±0.14[e]	0.67±0.20[f]
LSD	1.58	0.181	0.028

Each value is represented as mean ± standard deviation (n = 3).

Mean under the same column bearing different superscript letters are different significantly ($p \leq 0.05$).

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التأثير المضاد للسمنة للأسبرجس والبروكلى فى الفئران المصابة بالسمنة

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الملخص العربى

تم تقييم تأثير تركيزات مختلفة (٥ ، ١٠%) فى صورة مسحوق من الأسبرجس والبروكلى في الفئران المصابة بالسمنة. واستخدم ٤٨ فأر في هذه الدراسة وتم تقسيمها إلى ٦ مجموعات، كل مجموعة تحتوي على ٨فئران. وتم اصابة الفئران بالسمنة بالتغذية على وجبة عالية الدهون (٢٠ % دهن حيوانى) بمرض السمنة. وأظهرت النتائج أن أعلى قيم للزيادة فى وزن الجسم، كمية الغذاء المتناول وكفاءة استخدام الغذاء سجلت مع تركيز ١٠ % مخلوط ، ٥% أسبرجس، ١٠% بروكلى على التوالى مع وجود فرق معنوى. أعلى انخفاض لإنزيمات الكبد ALP , AST,ALT سجلت مع مجموعة الفئران التي تغذت على ١٠ % مخلوط مع وجود فرق معنوى .أقل قيمة من الدهون الثلاثية والكوليسترول مع مجموعة الفئران التي تغذت على ١٠ % مخلوط مع وجود فرق معنوى. فى حين أعلى قيم للكوليستيرول عالى الكثافة سجلت مع مجموعة الفئران التي تغذت على ١٠ % من مخلوط الأسبرجس والبروكلى. بينما أقل قيم من الكولسيتيرول منخفض الكثافة والكولسيتيرول منخفض الكثافة جدا سجلت مع مجموعة الفئران التي تغذت على ١٠ % من مخلوط الأسبرجس والبروكلى ، وأقل قيم لليوريا وحمض اليوريك والكرياتينين سجلت مع مجموعة الفئران التي تغذت على ١٠ % من مخلوط الأسبرجس والبروكلى .

الخلاصة وجد أن مجموعة الفئران المصابة بالسمنة والتي تغذت على ١٠ % من مخلوط الأسبرجس والبروكلى سجلت أفضل النتائج فى تحسين صورة دهون الدم ووظائف الكبد والكلى بالمقارنة بالفئران المصابة بالسمنة والتى تغذت على مسحوق الأسبرجس أوالبروكلى على حده.

الكلمات الأفتتاحية: الأسبرجس . البروكلى ـ الفئران . التأثير المضاد للسمنة . التحاليل الكيميائية الحيوية.