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Fenugreek powder to help Prevention female infertility induced by obesity in female albino rats

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Abstract

Infertility in women is a health problem that may sometimes be due to obesity This study aimed to estimate the influence of Fenugreek in different concentrations of obese induced infertile female albino rats. 28 and 7 white male albino rats were divided into 7 groups (5 rats for each group, 4 female and one male) weighing 220 ± 5g. The female rats in the first group were fed on a basal diet as a negative control; in the second group female rats were fed on a high-fat diet to induce obesity and were used as a positive control group. Females in fed on a high-fat diet with fenugreek powder. Bodyweight gain, feed intake, and feed efficiency ratio were calculated, lipid, liver and kidney functions, were determined. Hormones (LH, FSH, and Estradiol) were measured. The effect of fenugreek on the fertility of obese induced female rats was estimated by determining the number of fertile females after mating and pregnancy and the number of offspring. The results revealed a significant performance of fenugreek as a treatment of infertility induced by obesity as well as improvement of the health. Group 7 where the highest (7.5%) of fenugreek was used recorded the highest fertility, the highest LH, FSH, and estradiol levels 25.5 , 44 and 8.6 respectively In addition, the best lipid profile, liver, and kidney functions were obtained. This study demonstrated that fenugreek powder could be a promising approach to help Prevention infertility disorders induced by obesity.

Key words:, women, Hormones, liver, kidney functions

Introduction

Fenugreek powder could be a to help Prevention treating infertility disorders induced by obesity ,Infertility is a global health issue that is described as a couple's inability to conceive after one year of unprotected sexual activity **(Coutton et al., 2016).** It affects approximately 8-10% of couples (i.e. one couple of every six couples) (Kazemijaliseh et al., 2015 and Saeed et al., 2021). Female infertility represents about one-third of the cases of infertility affecting couples **(Sudha and Reddy, 2013).**Generally there are several factors that could be contributed to female infertility including chromosome abnormalities, ovulatory disorders (e.g., hypothalamic and hyperprolactinaemic anovulation, polycystic ovarian disease and premature ovarian failure), deterioration of oocyte quality, tubal infertility,

endometriosis, implantation failure, recurrent miscarriage, psychological and occupational factors and lifestyle factors including dietary, clothing, and exercise habits, as well as alcohol, tobacco, and recreational drug use (e.g., marijuana) **(Sudha and Reddy, 2013 and Silvestris *et al.*, 2018) .**

Obesity is an essential factor that results due to unhealthy lifestylesand was evident to have a key role in reproductive problems, notably in females. Female infertility induced by obesity could be due to menstrual dysfunction and anovulation resulting from being overweight. Obesity also increases the chance of assisted reproduction issues, miscarriage rates, and negative pregnancy outcomes **(Sudha and Reddy, 2013 and Talmor and Dunphy, 2015).**

The annual plant fenugreek (Trigonella foenum-graecum) belongs to the Fabaceae family **(Khan *et al.*, 2018) .** About 90% of the world production of fenugreek comes from India, China, Iran, Pakistan, and Palestine. It is used as a daily food component for several nations and countries, without any adverse effects Fenugreek dietary supplements are synthesized from powdered seeds in the form of capsules, loose powders, teas, and liquid extracts and are available in many countries. **(Ben Hameid *et al.*, 2019).** Fenugreek has potential restorative and nutritive properties. Both leaves and seeds of fenugreek have a high content of iron and hence have a high haematinic value, rich in vitamins A, B and C that can be further enhanced via germination. Fenugreek is also rich in proteins with essential amino acids, ascorbate and folate content **(Al-Asadi, 2014 and Ali *et al.*, 2021).** Fenugreek seeds are reported to have several medicinal properties such as hunger stimulant, antidiabetic, hypercholesterolemic, anti-inflammatory, hepatoprotective against free radicals, gastroprotective, and breast and colon cancer protection **(Brogi *et al.*, 2019) and Grzesiak *et al.*, 2021).** As well as, fenugreek was found to raise blood haemoglobin immune functions in mice by increasing the phagocytic index and phagocytic capacity of macrophages (**Pałka *et al.*, 2021).**

Recently, the various medical benefits and effects of fenugreek on female gonadal hormones and their reproductive functions have been extensively addressed in numerous studies **(Ben Hameid *et al.*, 2019 ; Ghani *et al.*, 2020 and Elfituri *et al.*, 2021).** The aim of this research is to evaluate the performance of dietary supplementation of fenugreek powder toward female infertility induced by obesity using obese female albino rats.

Materials and Methods

Materials

Fenugreek seeds were obtained from the local market, Cairo Governorate, Egypt. Casein, cellulose, choline chloride powder, and DL- methionine powder, were obtained from Morgan Co. Cairo, Egypt.

A total of 35 adults normal Sprague Dawley cyclic rats (28 females and 7 males) weighed 220±10 g, and were received from the Ministry of Health's Vaccine and Immunity Organization, Helwan Farm, Cairo, Egypt. The rats were kept were kept in the Experimental Animals' room at the Physiology Laboratory in the Faculty of home economics. The female rats were housed in separate cages from the males, with seven rats per cage during the feeding period.

However, during the mating period, the rats were housed in seven cages, one male with four females in each cage. While during pregnancy, males were separated again from females, and each pregnant female was housed in a separate cage till delivery.

The standards authentic samples such as gallic acid, catechin, chlorogenic acid, caffeic acid, tyrosol, rutin, ferulic acid, quercetin, synergic acid, and cinnamic acid were purchased from Sigma-Aldrich USA. In addition, kits used for determination were obtained from Al-Gomhoria Company for Chemical, Medical and Instruments, Cairo, Egypt.

Methods

Characterization of phenolic acid from Fenugreek powder by HPLC

Fenugreek powder was prepared by grinding dried fenugreek seeds obtained from the local market. Prepared powder 1 g was mixed with 50 ml of 50% methanol. The combined filtrates were evaporated on the hot plate for up to 25 ml. Then characterization of fenugreek powder was performed in order to determine active phenolic components using high-performance liquid chromatography (HPLC Shimadzu, LC- 6AD), 20 µL of the extract was injected and absorbance was measured at 280 nm according to the method described by AOAC, (2010).

Experimental design

Twenty-eight white female and seven white male Sprague Dawley cyclic rats weighed 220±10g were used in this experiment. All rats were fed on a basal diet prepared according to (Ain, 1993) for 7 consecutive days as an acclimatization

period. After this period, rats were divided into 7 groups based on the basal diet used, each group contained five rats, one male, and four females. Group 1 contained the normal healthy male and female rats that were fed on a basal diet and was considered a negative control group. Group 2 contained one normal healthy male rat and four obese induced female rats, the obesity was induced by introducing a high-fat diet (20% animal lipid) supplement in the basal diet, and this group was considered a positive control group. The same basal diet protocol as in group 2 was used with the addition of different percentages of fenugreek powder at levels 1.5, 3, 4.5, 6, and 7.5 % to the basal diet of groups 3, 4, 5, 6, and 7, respectively. Then after 20 days of the diet used in each group, and evaluation of estradiol, LH, and FSH was carried out by the technique of EIA (Enzyme Immunoassay), according to **Tietz (1995)** and also, males were allowed to mate with females, and then they were separated after confirming the occurrence of pregnancy. After 20- 23 days they gave birth, the number of pregnant females and offspring was recorded for each group.

The body weight and food consumption were recorded every three days for six weeks. Then feed efficiency ratios (FER) were calculated from net feed intake and gained body weight according to **Chapman *et al.* (1959)** as following equation.

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

After the experiment, blood samples were collected from the orbital plexus and centrifuged at 3000 rpm to obtain serum, which were then maintained in a deep - freezer at -20°C until they were analyzed.

Triglycerides, total cholesterol, HDL and (LDL) were determined according to the method of **Fossati and Principe (1982), Allain *et al.* (1974)**, **Lopes-Virella *et al.* (1977)** and **Steinberg (1981),** respectively.

VLDL-c was calculated in mg/dl according to **Lee and Nieman (1996)** as the following equation **VLDL-c (mg/dl) = Triglycerides / 5**

Liver function as Alanine (ALT) and Aspartate (AST) transaminoferase were determined according to the method described by **Reitman and Frankel (1957).**

Serum urea and creatinine were determined by the enzymatic method according to Henry (1974) and Patton and Crouch (1977). Serum uric acid was measured according to **Mazzali *et al.* (2001).**

Statistical analysis:

When a significant main effect was found, the data were examined using a totally randomized factorial design (Spss, 2000); the means were separated using the Student-Newman-Keuls Test. The Costat Program determined that differences between treatments of (P0.05) were significant. One Way ANOVA was used to assess the biological data

Results and Discussion

Identification and quantification of phenolic compounds in fenugreek seeds by HPLC

Active phenolic components of prepared fenugreek powder were characterized using high-performance liquid chromatography. Fenugreek powder was found to contain many phenolic compounds as shown in Table (1). fenugreek seeds were extracted caffeic acids, gallic acid, cinnamic acid, catechin and ferulic acid (**Shan *et al.*, 2005)** and **(Thippeswamy and Naidu, 2005).**

The highest concentrations of phenolic compounds observed for rutin, and caffeic acid, were 17.70 and 16.21% followed by quercetin, tyrosol, and ferulic acid were 14.69%, addition gallic acid was 13.46%, respectively. **(Thippeswamy and Naidu, 2005).**

Moreover, catechin and cinnamic acid (8.07 and 0.49%) were found in fenugreek extract. The presence of phenolic acids, such as vanillic acid, coumaric acid, ferulic acid, and gallic acid, in fenugreek seeds was confirmed by **Roberts *et al.* (2015).** These acids have a higher antioxidant potential than others. **(Sakhria et al., 2016),** and (**Pasha *et al.*, 2017).**

Table (1): Fractionation of phenolic compounds in fenugreek seeds using HPLC

Phenolic compounds	Concentration(mg/100g)
Caffeic acid	13.10
Gallic acid	10.88
Cinnamic acid	0.40
Catechin	6.52
Tyrosol	11.87
Chlorogenic acid	ND
Ferulic acid	11.87
Quercetin	11.87
Rutin	14.30

	80.81

ND= Not detecte

Effect of fenugreek on fertility of obese induced female rats

Data presented in Table (2) show the effect of fenugreek on the fertility of four female rats in each group. Different concentrations of the fenugreek seed powder were used to enhance the fertility of obese induced females in groups 3, 4, 5, 6, and 7. Generally, gradual elevation infertility was noticed with increasing the percentage of fenugreek in the basal diet Figure (1). The groups (3 and 4) fed on 1.5 and 3% fenugreek seed powder found that 3 females pregnant gave22 and 24 offspring, whereas, groups (5 and 6) fed on 4.5 and 6% fenugreek seed powder found that 4 females pregnant gave27 and 29 offspring, respectively. The complete recovery of infertility was recorded in group 7 by using 7.5% fenugreek; the results recorded indicate almost similar fertility as the negative group (four females give 31 offspring).The fertility was estimated through both the number of fertile females (i.e. females that delivered) and the total number of offspring. It was observed that in group 1 (negative control group) which represented the normal healthy rats, all females in the control negative group delivered about 32 offspring. Group 2 (positive control group) showed that a significant reduction in fertility was recorded; only one female was able to deliver about six offspring. The induced obesity in female rats is a major contributor to several etiologies associated with infertility. Obesity produces hyperinsulinemia and insulin resistance, which leads to hyperandrogenemia and steroidogenesis. It enhances ovarian estrogen, progesterone, and androgen synthesis in the theca cells. Insulin also boosts steroidogenesis by amplifying LH's action on granulosa cells. In the preovulatory follicle, LH increases steroidogenesis while inhibiting further mitosis and final differentiation of granulosa cells, resulting in follicle growth stoppage, menstrual cycle abnormalities, and obesity-induced oligo anovulation. **(Hillier, 1994)**. Excess adipose tissue also aggravates polycystic ovarian syndrome in women (PCOS), and **(Sharma *et al.*, 2013 and Dağ and Dilbaz, 2015**) which is confirmed in the next section. Obesity also contributes to infertility by impairing ovarian follicular growth, ocyte quality and quantity development, fertilization, embryo development, and implantation. **(Jungheim *et al.*, 2013).** Several studies have documented the role of fenugreek as a natural antifertility agent **(Ouzir *et al.*, 2016 and Hameid *et al.*, 2019).**

Table (2): Effect of fenugreek powder on fertility of obese induced female rats

Groups	Total number of offspring	Total number of fertile females
Group 1 Control negative (-)	32	4
Group 2 Control positive (+)	6	1
Group 3 (1.5% Fenugreek powder)	22	3
Group 4 (3% Fenugreek powder)	24	3
Group 5 (4.5% Fenugreek powder)	27	4
Group 6 (6% Fenugreek powder)	29	4
Group 7 (7.5% Fenugreek powder)	31	4

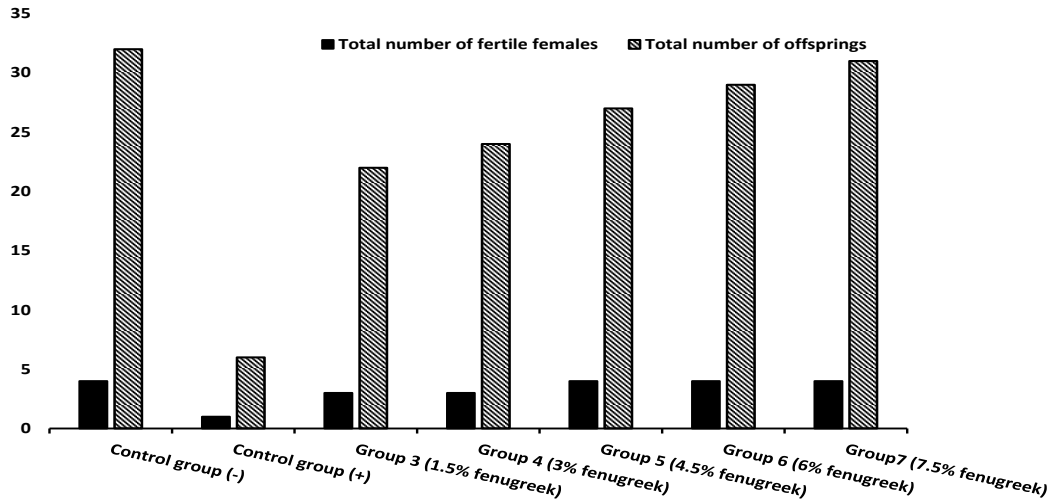

Figure (1): Effect of fenugreek powder on the fertility of obese female rats

Effect of fenugreek powder on body weight gain, feed intake and feed efficiency ratio of obese induced female rats

Table (3) revealed a lowering in body weight, feed intake, and feed efficiency of the experimental rats' different groups when compared with a positive control group of rats. When fenugreek seeds were used to treat obese induced female rats in groups 3, 4, 5, 6, and 7, the body weight gain, feed intake, and feed efficiency ratio levels were reduced gradually with increasing fenugreek concentrations in the basal diet from 32.31g, 18.33 g/day and 0.060%in the group (3) to 21.10g, 16.09g/day and 0.046% in the group (7), respectively. The group (7) showed the greatest reduction in body weight increase, feed intake, and feed efficiency ratio. This might be because fenugreek flushes out carbs from the body before they enter the circulation, resulting in weight loss. Fenugreek seeds also have a high concentration of soluble fibre (40%) in them. This fibre has a gelatinous structure (similar to guar gum) that may inhibit digestion and absorption of food in the gut, as well as provide a feeling of fullness in the abdomen, decreasing hunger and encouraging weight reduction. (**Helal *et al.*, 2019 and Bahnasy *et al.*, 2020**). The findings in this research are in agreement with (**Kumar *et al.*, 2014**) study which revealed the effect of fenugreek seeds on the reduction of fat accumulation and dyslipidemia through inhibiting poor fat digestion and absorption, as well as improvements in glucose and lipid metabolism, insulin sensitivity, antioxidant defense, and lipogenic enzyme downregulation. The enhancement of lipid metabolism after the use of fenugreek seeds was also confirmed in the next section (results of lipid profile). Moreover, Phenolic acids have been found to have a useful influence on obesity. Illustrating, dietary natural antioxidants such as polyphenols were a regulator for adipocyte metabolism to prevent the growth of adipose tissue **(Badimon *et al.*, 2010).**

Table (3): Effect of fenugreek powder on body weight gain, feed intake and feed efficiency ratio of obese induced female rats

Groups	BWG (g)	FI (g/day)	FER (%)
Control negative (-)	$18.30^{e} \pm 0.20$	$16.00^{c} \pm 0.30$	$0.043^{a} \pm 0.13$
Control positive (+)	$36.30^{a} \pm 0.50$	$21.00^{a} \pm 0.70$	$0.062^{a} \pm 0.15$
Group 3	$32.31^{b} \pm 0.50$	$18.33^{b} \pm 0.70$	$0.060^{a} \pm 0.11$
Group 4	$28.0^{c} \pm 0.40$	$18.02^{b} \pm 0.20$	$0.050^{b} \pm 0.11$
Group 5	$26.70^{c} \pm 0.90$	$17.51^{b} \pm 0.50$	$0.052^{a} \pm 0.04$
Group 6	$25.10^{cd} \pm 0.60$	$17.78^{b} \pm 0.20$	$0.049^{b} \pm 0.01$
Group 7	$21.10^{d} \pm 0.80$	$16.09^{c} \pm 1.00$	$0.046^{b} \pm 0.12$
LSD (P≤ 0.05)	1.820	1.271	0.014

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

Effect of fenugreek powder on Gonadotropin hormones (LH, estradiol and FSH) of obese induced female rats

The obtained results in Table (4) demonstrated the effect of fenugreek on LH, estradiol, and FSH hormones over a period of 20 days. LH, estradiol, and FSH hormones were significant reduction in the positive control group (10.4 g, 17.0 g/day and 5.40%) when compared with a negative control group with an elevated significant difference ($P<0.05$) was 24.4g, 48.4 g/day and 9.0%, respectively. The decreased levels of hormones were due to the high-fat diet-induced obesity which is known to affect reproductive efficiency via the high plasma FFA levels as shown in the next section which binds and activates TLR2 and TLR4 signaling in many cell types, mimic signaling pathways that are activated by GnRH in gonadotrope cells causes the dysregulation of gonadotropin expression and hence result in decreased Gonadotropin hormones **(Sharma *et al.*, 2013)**.

An enhancement of LH, estradiol, and FSH hormone levels was observed in the same table when fenugreek seed powder was added to the basal diet. The highest levels were recorded with the use of the highest concentration of fenugreek seed powder (7.5%) in the group (7). The levels of LH, FSH, and Estradiol were gradually elevated with increasing the concentrations of fenugreek due to the treatment of consequences induced by obesity through the reduction of free fatty acids that in turn enhance the regulation of gonadotropin expressions **(Sharma *et al.*, 2013**). Moreover, the increase of estradiol levels in the experimental rats after the addition of fenugreek seeds can be explained by the increased abundance of crucial steroidogenic enzyme proteins in the rats' ovary caused by fenugreek supplementation, resulting in decreased CYP17A1 and increased CYP19A1 protein abundance, followed by the expected reduction in tissue testosterone concentration, elevated estradiol concentration, and thus increased plasma estradiol concentration (**Grzesiak *et al.*, 2021**).

Table (4) Effect of fenugreek powder on gonadotropin hormones (LH, estradiol and FSH) of obese induced female rats.

Groups	LH (g)	Estradiol (g/day)	FSH (%)
Control negative (-)	$24.4^{a} \pm 0.89$	$48.4^{a} \pm 1.67$	9.0 ± 1.0^{a}
Control positive (+)	$10.4^{c} \pm 0.54$	$17.0^{e} \pm 1.10$	5.40 ± 0.54^{d}
Group 3	$14.0^{bc} \pm 1.20$	$27.0^{d} \pm 1.09$	7.0 ± 0.70^{c}
Group 4	$17.7^{b} \pm 1.50$	$30.0^{d} \pm 1.70$	7.4 ± 0.54^{bc}
Group 5	$22.2^{a} \pm 0.83$	$39.0^{c} \pm 1.20$	8.0 ± 0.70^{abc}
Group 6	$25.2^{a} \pm 0.98$	$43.0^{b} \pm 1.0$	8.3 ± 0.54^{ab}
Group 7	$25.5^{a} \pm 0.86$	$44.3^{b} \pm 1.70$	8.6 ± 0.57^{ab}
LSD ($P \leq 0.05$)	1.251	1.180	0.450

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

Influence of fenugreek powder on lipid profile level of obese induced female rats:

The influence of fenugreek on the serum total cholesterol and triglycerides of the experimental rats is shown in Table (5). The obtained results indicated that the cholesterol and triglycerides levels of the positive control group recorded the highest value (141.40 and 130.50 mg/dL) when compared with a negative control group with the lowest significant difference was 93.30 and 62.0 mg/dL, respectively. This was expected as obesity is associated with elevated blood lipids and lipoproteins. Also, there is a direct correlation between plasma triglycerides and body weight **(Bhatti *et al.*, 2001)**.

While the lowest gradually cholesterol and triglycerides levels were recorded for the different groups fed on fenugreek from 102.30 and 96.40 mg/dL in the group (3) fed on 1.5% fenugreek to 93.30 and 71.45 mg/ dL in the group (7) fed on 7.5% fenugreek seeds powder. Numerous studies showed the same highest reduction effect on TC and TG levels through the reduction of their absorption from the intestine due to fenugreek having contained the highest amount of insoluble dietary fiber **(Kassaian *et al.*, 2009 and Gupta and Verma, 2015)**.

The effect of fenugreek on serum lipid profile (HDL-c, LDL-c, and VLDL-c) levels of infertility rats was shown in the same table. The results indicated that a reduced HDL-c in the positive control group when compared with the negative control rats group, recorded the highest value when compared with a significant difference (P<0.05). The highest HDL-c of the treated group was recorded for the group fed on 7.5% fenugreek with a significant difference (P<0.05) Followed by the group fed on 6% fenugreek. On the other hand, the LDL-c, and VLDL-c of the positive control rats group recorded the highest value when compared with a negative control group with a significant difference (P<0.05). The lowest values of LDL-c, and VLDL-c were obtained for the group fed on 7.5% fenugreek with a significant difference (P<0.05). The same findings were documented in several studies **(Benjamin *et al.*, 2019 and Ghobadi *et al.*, 2019).** A negative association between HDL and incidence of obesity, lipid-lowering effect of fenugreek may be due to the saponin and galactomannan of fenugreek that can suppress fast assemblage and upregulate low-density lipoprotein receptor (**Vijayakumar *et al.*, 2010**). Fenugreek seeds are as an anti-cholesterol and weight-loss substance. The seeds of fenugreek have been proven to have hypoglycemic, hypolipidemic, and antioxidant properties **(Marzouk *et al.*, 2013).**

Table (5): Effect of fenugreek powder on lipid profile level of obese induced female rats mg/dl

Groups	Total cholesterol	Triglycerides	(HDL-C)	(LDL-C)	(VLDL-C)
Control negative (-)	93.30±1.16^{d}	62.00±1.10^{f}	44.00±1.14^{a}	39.60±1.20^{f}	13.50±1.13^{e}
Control positive (+)	141.40±1.17^{a}	130.50±1.16^{a}	25.33±1.13^{d}	84.30±1.16^{a}	27.50±1.14^{a}
Group 3	102.30±1.13^{c}	96.40±1.15^{c}	29.00±1.20^{cd}	58.60±1.15^{b}	21.50±1.13^{b}
Group 4	96.40±1.14^{d}	84.40±1.13^{d}	30.30±1.13^{c}	55.50±1.13^{c}	19.70±1.12^{c}
Group 5	108.40±1.13^{b}	100.50±1.14^{b}	31.00±1.13^{c}	47.40±1.12^{d}	17.20±1.10^{d}
Group 6	101.10±1.15^{c}	86.40±1.15^{d}	35.10±1.2^{b}	43.10±1.12^{e}	16.90±1.13^{d}
Group 7	93.30±1.12^{d}	71.45±1.2^{e}	36.40±1.14^{b}	40.20±1.14^{f}	14.30±1.11^{e}
LSD (P≤ 0.05)	4.041	3.210	1.651	1.903	1.015

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

Effect of fenugreek powder on liver functions of obese induced female rats

Data given in Table (6) show the effect of fenugreek on liver functions (AST and ALT) of the experimental rats. The obtained results indicated that the AST and ALT enzymes of obese induced female rats group recorded the highest value (230.5 and 79.50 U/L) confirmed with **Bhandari *et al.* (2011)** reported that the obesity raises the levels of hepatic and cardiac indicators including ALT, AST, and LDH, according to research. Furthermore, the lowest significant difference in the negative control group was 109.50 and 51.0 U/L, respectively. Hepatomegaly and changes in liver histology such as macrovesicular steatosis, steatohepatitis, fibrosis, and cirrhosis are strongly linked to obesity. Increased liver biochemistry levels due to changes in liver histology such as macrovesicular steatosis, steatohepatitis, fibrosis, and cirrhosis (ALT, and AST) **(Wu *et al.*, 2013).**

When fenugreek was used in the basal diet, the levels of AST, and ALT were noticed to be decreased. The lowest value was recorded in group (7) where the highest concentration of fenugreek (7.5%) was used. These results showed that high-fat diet control rats are prone to hepatic and cardiac problems due to higher levels of these enzymes. Fenugreek treatment at various doses effectively lowered elevated LDH, AST, and ALT levels. These findings are in agreement with (**El-Wakf *et al.*, 2015**). **Reddy and Srinivasan, (2011)** discovered that dietary fenugreek has hepatoprotective properties, owing to its ability to reduce the blood levels of liver function enzymes such as aminotransferases, LDH, and alkaline phosphatase,

presumably by preventing the leakage of these enzymes from hepatic tissue. Fenugreek also has a strong antioxidant activity, scavenging hydrogen peroxide and DPPH radicals and preventing lipid peroxidation. Gallic acid, which is known to have antioxidant properties, is present in the aqueous extract **(Srinivasan, 2014).**

Table (6): Effect of fenugreek powder on liver functions level of obese induced female rats

Groups	AST (U/L)	ALT (U/L)
Control negative (-)	109.50^{f} ±1.70	51.0^{e}±0.80
Control positive (+)	230.50^{a}±1.85	79.50^{a}±1.40
Group 3	210.0^{b} ±1.50	71.00^{c} ±1.20
Group 4	179.0^{d} ±1.30	65.40^{d} ±0.90
Group 5	213.5^{b} ±1.40	75.40^{b} ±0.80
Group 6	184.40^{c} ±1.10	69.50^{c} ±0.60
Group 7	148.0^{e} ±1.30	63.50^{d} ±0.40
LSD (P≤ 0.05)	4.264	2.610

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

Effect of fenugreek powder on kidney functions level of obese induced female rats

Data presented in Table (7) show the effect of fenugreek on the kidney functions (uric acid, urea, and creatinine) level of experimental rats. The obtained results revealed the elevated levels of creatinine, uric acid, and urea in the positive control rats group when compared with a negative control group with a significant difference (P<0.05). Obesity affects renal function in two ways: indirectly through hypertension and diabetes mellitus, and directly through the production of adipokines, which cause inflammation, oxidative stress, and abnormal lipid metabolism, as well as the activation of the renin-angiotensin-aldosterone system, increased insulin production, and insulin resistance. These variables cause ectopic lipid buildup in renal tissue, resulting in glomerular hypertension, increased glomerular permeability, hyperfiltration, glomerulomegaly, albuminuria, and even localised segmental glomerulosclerosis (FSGS) (**Ding *et al.*, 2015 and Chang *et al.*, 2018**).

Furthermore, the lowest values were recorded for the group fed on 7.5% fenugreek with a significant difference (P<0.05). These results are in agreement with a study that reported a lowered serum level of kidney function markers including urea, uric acid and creatinine in diabetic rats with a fenugreek supplemented diet (**Eidi *et al.*, 2007**). on the other hand, **Jin *et al.* (2014)** concluded that renal dysfunction is associated with renal morphological alterations, and fenugreek could

reduce the risk of renal dysfunction by preventing injuries to the structural/cellular basis.

Table (7): Effect of fenugreek powder on kidney functions of obese induced female rat

Groups	Creatinine (mg/dl)	Urea (mg/dl)	Uric acid (mg/dl)
Control negative (-)	1.90±1.20^{e}	26.30±1.01^{f}	1.90±1.14^{d}
Control positive (+)	4.50±1.13^{a}	49.00±1.20^{a}	4.00±1.21^{a}
Group 3	3.60±1.11^{b}	39.50±1.12^{b}	3.10±1.13^{b}
Group 4	3.03±1.10^{c}	36.40±1.13^{c}	2.80±1.10^{b}
Group 5	3.02±1.11^{c}	34.20±1.40^{d}	2.70±1.13^{b}
Group 6	2.88±1.13^{d}	32.60±1.10^{e}	2.50±1.12^{c}
Group 7	2.01±1.12^{e}	27.10±1.14^{f}	1.92±1.12^{d}
LSD (P ≤ 0.05)	0.624	1.680	0.535

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

CONCLUSION

The findings of this study suggest that fenugreek seeds have a high potential of enhancing rats female infertility induced by obesity, this is via the help Prevention consequences of obesity in terms of reducing the lipid profile and body weight, elevating LH, FSH, and estradiol hormones. In addition, the use of fenugreek resulted in improving general health by enhancing liver and kidney functions due to the fenugreek having contained the highest amounts of which scavenged the blood from free radicals and contained soluble and insoluble dietary fiber which improved the lipid profile and liver and kidney functions.

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مسحوق الحلبة عامل مساعد فى الوقاية من عقم النساء الناجم عن السمنة

في إناث الفئران البيضاء

عزيزة حافظ عبد الظاهر صبح
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الملخص العربى

يُعد العقم عند النساء مشكلة صحية قد تكون احيانا بسبب السمنة. هدفت هذه الدراسة إلى تقدير تأثير تراكيز مختلفة للحلبة في عقم إناث الفئران البيضاء المصابة بالسمنة. تم تقسيم 28 أنثى و7 ذكور من الفئران البيضاء إلى 7 مجموعات (5 فئران لكل مجموعةمنهم 4 إناث وذكر واحد) بوزن 220 ± 5 جم. تغذت المجموعة الأولى على النظام الغذائي الأساسي كمجموعة ضابطة سلبية ؛ في المجموعة الثانية تغذت إناث الفئران على نظام غذائي عالي الدهون للحث على السمنة كمجموعة إيجابية. تغذت إناث 7 على نظام غذائي عالي الدهون و مسحوق الحلبة على التوالي. تم حساب زيادة وزن الجسم ، وكمية العلف المتناول ، ونسبة كفاءة التغذية ، وكذلك تحديد الدهون ، ووظائف الكبد ووظائف الكلى. ثم قياس هرمونات الغدد التناسلية (LH، FSH ، و Estradiol). وتم تقدير تأثير الحلبة على خصوبة إناث الفئران المصابة بالسمنة من خلال تحديد عدد الإناث الخصبة بعد التزاوج والحمل وعدد النسل. كشفت النتائج عن ارتفاع معنوي للحلبة للمساعد في الوقاية للعقم الناجم عن السمنة وكذلك تحسين الصحة العامة للمجموعة (7.5٪) للحلبة مسجلة أعلى معدلات الخصوبة وأعلى مستويات الهرمون (LH, FSH, and estradiol) بالإضافة إلى الحصول على أفضل نتائج للدهون ووظائف الكبد و الكلى. وأظهرت هذه الدراسة أن بذور الحلبة يمكن أن تكون نهجًا واعدًا للمساعد فى الوقاية من العقم الناجم عند التي تسببها السمنة.

الكلمات المفتاحية: ، النساء ، الهرمونات ، وظائف الكبد ، الكلى.