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المجلة العلمية المحكمة لدراسات وبحوث التربية النوعية

المجلد الثالث– العدد الأول– مسلسل العدد (٥)– الجزء الأول، يناير ٢٠١٧

رقم الإيداع بدار الكتب ٢٤٢٧٤ لسنة ٢٠١٦

ISSN-Print: 2356-8690 ISSN-Online: 2356-8690

موقع المجلة عبر بنك المعرفة المصري https://jsezu.journals.ekb.eg

البريد الإلكتروني للمجلة E-mail JSROSE@foe.zu.edu.eg

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Abstract:

This study was designed to determine the effect of basil powder and oil on postmenopausal female rats. The study was carried out on thirty female albino rats were classified into six groups. The first group (5 young rats) aged between 7 to 9 weeks, weight from 80 to 95 g kept as control negative fed basal diet only. The others 25 rats aged between 19 to 21 weeks, weight from 200 to 205 g were classified into five groups (5 rats) each, as following : Group 2 (+ve), Groups (3 and 4) treated with basil powder (5 and 10% of diet), Group (5 and 6) treated with basil oil (0.5 and 1 ml/kg b.w) orally by stomach tube respectively, daily for 8 weeks. The results indicated that all treating animals showed highest significantly in BWG , FI , FER, HDL-c ,BMD ,BMC ,Ca, ionized Ca, P ,estrogen, osteocalcin and alkaline phosphates while showed lowest significantly in the TC, TG, LDL-$_C$ and VLDL-$_C$ as compared to the control positive group. As a result, the best values of these variables appeared in basil powder (10%) and basil oil (1.0 ml) compared with other treated groups, therefore were used during preparation of biscuit .The results of chemical composition revealed that biscuit with basil powder had the highest values of protein, ash and crude fiber in comparing with control biscuits, On the other hand the highest total phenolic and flavonoid contents were that of the biscuits with basil oil then powder, biscuits with basil oil and powder showed lower amounts of peroxide and TBA value after 30 days storage period at degree room temperature in comparing with control biscuit. The results of physical properties indicated that biscuits with basil powder has the maximum spread ratio, while the scores of the sensory evaluation revealed that biscuit with basil oil showed higher values of color and flavour in comparing with control biscuit. Therefore, basil powder and oil is

recommended for nutritional and healthy advantages for female who suffer from postmenopausal symptoms.

Key words: Basil, estrogen , bone loss, rats, biscuit.

Introduction:

Basil (*Ocimum basilicum* L.) is an aromatic herb, belonging to the *Lamiaceae* family, typically called sweet basil, Holy basil in English ,Tulsi in Hindi and Rehan in Egypt **(Delille, 2007 and Farag, 2013)**. Basil leafs are used in the treatment of many diseases such cancer, diarrhea, epilepsy, gout, nausea, sore throat, relieves inflammation, inhibit gastric ulcers, improve digestion and improves stamina **(Simon *et al*., 1990; Khalid *et al*., 2006 and Maheshwari *et al*., 2012).**

The antioxidative effect of basil is owing to its content of phenolic components, such as phenolic acids, flavonoids, rosmarinic acid and aromatic compounds **(Gülçin *et al*., 2007)**. Basil had been found to contain linalool, eugenol, methyl cinnamate, ferulate, methyl eugenol, methyl chavicol, triterpenoids and steroidal glycoside known to exhibit antioxidant activities **(Siddiqui *et al*., 2007a ; Siddiqui *et al*., 2007b and Zheljazkov *et al*., 2008).**

Essential oil extracted from fresh leaves and flowers of basil containing nice aroma. It is known to have anti-inflammatory, antimicrobial, insecticidal, potent antioxidant and radical scavenging activities **(Suppakul *et al*., 2003; Burt, 2004; Bozin *et al*., 2006; Khalid *et al*., 2006; Hanif, 2011 and Monokesh *et al*., 2013).**

Menopause is the period in a woman's life when hormonal changes cause menstruation to cease permanently **(Andrews, 1995)** and may be accompanied by psychological and physical symptoms **(Bush, 2006)**. This is attributed to ovarian failure and estrogen decrease which will affect the quality of life **(Coad and Dunstall, 2005)**.

Postmenopausal osteoporosis, which is believed to be associated with ovarian hormone deficiency, is by far the most common cause of age-related bone loss **(Blazej and Adam, 2009)**. With the reduction in estrogen levels, there is an increase in bone breakdown related to bone formation, micro architectural deterioration and reduction bone mass **(Cole *et al*., 2008)**. Therefore, the present study aimed to investigate the effect of basil powder and oil on postmenopausal female rats.

Materials and Methods:

Materials:

Basil (*Ocimum basilicum* L.) powder and its oil were obtained from Agriculture Research Center, Giza, Egypt. Wheat flour (72%) was obtained from Milling Company, Dakahlia, Egypt. Casein, cellulose, all vitamins and minerals were purchased from El-Gomhoryia Company, El-Mansoura city, Egypt. Corn oil, baking powder, vegetable shortening, salt, sugar and starch were purchased from the local markets. Kits were obtained from Biodiagnostic Co. Egypt. Thirty Sprague Dawley female rats weighting 200 ± 5g were obtained from Agricultural Research Center, Giza, Egypt.

Methods:

Biscuits preparation:

The biscuit formulas was prepared according to the following ingredients: flour 100 g, baking powder 3 g, water 26.1 ml, vegetable shortening 20 g, salt 1 g and sugar 40 g, biscuit were baked in oven at 230 ^{o}C for 10-15 min, then packed in polyethylene bags after cooling until the analysis were done according to **Abd El-Magied (1991).**

Three types of biscuit were prepared as follow:

- Control biscuit was made from 100% wheat flour.
- Biscuit with basil powder was prepared by substituting 10% of wheat flour.
- Biscuit with basil oil was prepared by substituting 1ml of vegetable shortening.

Storage and analysis of biscuits:

Prepared biscuits were then stored at room temperature and analyzed after each 10 days of interval from 0 day to 30 days through different phyto-chemical and sensory parameters.

Physical analysis:

Physical characterizations of biscuits: Physical parameters such as weight, thickness, diameter and spread ratio were determined using **A.O.A.C (2000)**.

Sensory Evaluation of biscuit:

Twenty panelists from the staff-member at Home Economics Department, Faculty of Specific Education, Mansoura University, selected for sensory evaluation of biscuit. Each panelist had an evaluation sheet and was asked to rank un- fortified biscuit and fortified biscuit with basil powder and oil for colour, taste, crispiness, texture, flavour and overall acceptability by using 9-Point Hedonic Scale sensory evaluation parameter as described by **Meilgaard *et al*. (2007)**.

Chemical Constituents of Raw Materials and biscuit:

Moisture, protein, crude fibers, fat content and ash contents were determined according to the method described in the **A.O.A.C. (2000).** Total carbohydrates were calculated by difference. Total phenolic was determined according to **Singleton *et al*. (1999).** Total flavonoid was determined according to **Zhishen *et al*. (1999).** Thiobarbituric acid (TBA) was determined according to **Lemon (1975)**. Peroxide value (PV) was determined according to **Leonard *et al*. (1987)**.

Biological Experiment:

Standard Diet:

Was prepared according to **NRC (1995).**

Experimental Design:

Animals were reserved in the laboratory in plastic cages under stable temperature (24±2°C). All rats were fed on basal diet only for 7 days before starting the experiment for habituation. After that, the animals were randomly allocated into six equal groups, the first group (5 young rats) aged between 7 to 9 weeks, weight from 80 to 95 g kept as control negative fed basal diet only. The others 25 rats aged between 19 to 21 weeks, weight ranged 200 to 205 g were classified into five groups (5 rats) in each group, as following : Group 2 (+ve), Groups (3 and 4) treated with basil powder (5 and 10% of diet), Group (5 and 6) treated with basil oil (0.5 and 1 ml/kg b.w) orally by stomach tube respectively , daily for 8 weeks. The food intake was calculated daily and the body weight gain was recorded weekly **(Chapman *et al*., 1950).** Food efficiency ratio (FER) was calculated as FER=weight gain (g)/ food intake (g). At the end of experiment (8 weeks), rats were sacrificed.

Blood samples were collected into clean centrifuge tubes to obtain the serum which used for biochemical analyses.

Biochemical Analysis:

Bone mineral density:

Bone mineral of the left femur and tibia of each rat were measured by dual X-ray absorptiometry (DXA, mdel DCS-600A, Aloca, Tokyo, Japan). For evaluation of bone mass in lumbar vertebrae bone mineral densitometry were performed calcium and phosurous according to (**Fraser, *et al*., 1986**). Serum calcium, ionized calcium and phosphorous in serum were determined by spectrophotometer using commercially available test kit **(Furuichi *et al*., 2000 and Fishman, 1953).** Also, osteocalcin, estrogen and alkaline phosphatase in serum was determined by enzyme immunoassay **Owens and Ashby (2002); Shoji *et al*., (2003) and Varley, *et al*. (1980)**, respectively.

Serum total cholesterol, triglycerides and Serum high density lipoprotein cholesterol (HDL-c) were determined according to the methods of **Ratliff and Hall (1973); Jacob and Van-Denmark (1963)** and **Lopez (1977).** Low density lipoprotein cholesterol (LDL-c) and very low density lipoprotein cholesterol (VLDL-c) were calculated according to **Lee, and Nieman (1996).**

Statistical Analysis:

Data were presented as means± SE. Statistical analysis was performed using computerized Statistical Package Social Sciences (SPSS) program with one-way analysis of variance (ANOVA) followed by Duncan's multiple range tests according to **Snedecor and Cochran, (1986).**

Results and Discussion:

Chemical composition of control biscuits and biscuits with basil powder and oil were determined in table (1). The tabulated results it could be noticed that the highest moisture and fat contents were that of the control biscuits while, the lowest content was that biscuits with basil powder. Results of protein, ash and crude fiber contents in biscuits with basil powder had the highest values (11.03, 2.90, 12.13%) while, in control biscuits the amounts of these contents were lowest (9.84, 2.47,

12.02%) respectively. These results are in harmony with those obtained by **(Zahid Sarfraz *et al*., 2011 and Supriya Rattan *et al*., 2014).**

The results in Table (2) indicated that the highest total phenolic and flavonoid contents were that of the biscuits with basil oil then powder while the lowest content was that control biscuits , biscuits with basil oil gave best results after 30 days storage period at degree room temperature . Storage has profound effect on peroxide value and TBA value and they were increased with increase in storage, biscuits with basil oil and powder showed lower amounts of peroxide and TBA value after 30 days storage period in comparing with control biscuits. These results were in agreement with **Zahid Sarfraz *et al*. (2011**). Another study by **Dasgupta *et al*. (2007) and Hussain *et al*. (2008)** revealed that leafs of basil are rich source of flavonoids which have possess many biological properties owing to their ability as antioxidants.

The effect of basil powder and oil on physical properties of biscuit such as weight, thickness, diameter and spread ratio were studied and given in Table (3). The result showed that control biscuits has the maximum thickness(9.3) followed by biscuits with basil oil (8.33) and biscuits with basil powder (7.5). These data are confirmed with **Sharif *et al*. (2009; Tiwari *et al*. (2011) and Mishra and Chandra (2012).**Whereas diameter was decreased in biscuits with basil powder and oil but diameter was increased in control biscuits. These results were agreement with the findings of **Abd El-Hady (2012) and Kumar *et al*. (2010).** The spread ratio of biscuits which is the ratio between the diameter and the thickness increases. Spread ratio is the most important parameter to assess the quality of biscuits **(Bose and Shams-Ud-Din, 2010).** Biscuits with basil powder has the maximum spread ratio (5.6) followed by biscuits with basil oil (4.92) and control biscuits (4.83). These results are in parallel with those obtained by **Eissa *et al*. (2007)** who found that biscuits with high values of spread ratio are best.

The scores of the sensory evaluation of control biscuit, biscuit with basil powder and oil were shown in table (4). In general, a control biscuit was the most accepted by the judges . The score values of taste ,crispiness, texture and overall acceptability in biscuits with basil powder and oil were lower in compared to control biscuit. While biscuit with basil oil showed higher values of color and flavour in comparing with

control biscuit. These results may be due to presence of phenolic components of the oil, such as flavonoids, phenolic acids, eugenol, thymol, linalool and terpenoids which acts as antioxidant agent and neutralizing free radicals **(Vats *et al*., 2004 and Suanarunsawat *et al*., 2010).** On the other side, the results indicated that all organoleptic parameters decreased gradually and slightly by increasing the storage period. Also the addition of basil powder and oil to the biscuit increased the stability of sensory scores during storage. This may be related to the basil powder and oil could reduce the oxidation. The obtained results were in good accordance with **Zahid Sarfraz *et al*. (2011).**

The obtained results in Table (5) indicated that control positive group recorded significantly lower in body weight gain (BWG) ,food intake (FI) and Food efficiency ratio (FER) in comparison of negative control group. Animals treated with basil powder and oil showed significantly reduction in BWG and FER, except the groups treated with basil oil had a non-significant in BWG, while all treating animals showed a non significant difference in FI compared with negative control group, but all treating animals caused significant higher in BWG, FI and FER in comparison of positive control group. These results may be as a result of nutritional values of basil powder and oil because of an excellent source of vitamins A, K, and C, magnesium, iron, potassium, and calcium. Also leafs of basil are rich source of flavonoids which improve the biological functions for its antioxidant properties. These results are in harmony with those obtained by **Juntachote and Berghofer (2005) and Amita Bhargava *et al*. (2013).**

The obtained results in Table (6) illustrated that control positive group recorded highest significantly in TC, TG, LDL-c, and VLDL-c, but showed lowest significantly in HDL-c in comparing with negative control group. Animals treated with basil powder and oil recorded highest significantly in TC , TG , LDL-c and VLDL-c and showed lowest significantly in HDL-c except the group treated with basil oil (1.0 ml) had a non-significant in TC , TG , HDL-c, and VLDL-c in comparing of negative control group while led to lowest significantly in these previous parameters and led to highest significantly in HDL-c compare with the control positive group. The results are in agreement with **Suanarunsawat and Songsak (2005)** who reported that 2% of basil leafs powder

supplemented in the diet can decrease serum lipid profile. Additionally, **Hicham *et al*. (2009) and Shama (2012)** found that basil reduce raised blood sugar, cholesterol and triglyceride levels and alkaline phosphatase in blood serum and thereby it is therapeutically used as hypolipidemic and antidiabetic. These results are in parallel with **(Sarkar *et al*., 1994; Arfa and Rashed, 2008; Suanarunsawat *et al*., 2009 and Maheshwari *et al*., 2012)**.

Table (7) presented that control (+ve) rat group showed lowest significantly in bone mineral density (BMD) and bone mineral content (BMC) in comparing with negative control group, animals treated with basil powder and oil recorded a significant reduction in BMD and BMC in comparison of negative control group, but showed highest significantly in BMD and BMC in comparing of positive control group. These results were in agreement with **Schett (2011)** reported that increased the amount of phytochemical intake reduces inflammation and bone loss associated with ageing .Additionally, Phytoestrogens inhibit bone resorption, protect bones, increase bone density and prevent osteoporosis in postmenopausal women, due to their estrogenic activity because they are improbable to cause the negative effects associated with steroid hormones **(Abdallah *et al*., 2010 and Taku *et al*., 2011)**. The profound medical effects of basil may be due to its antioxidant power as a result of polyphenols and flavonoids content **(El-Beshbishy *et al*., 2011 and Supriya Rattan *et al*., 2014)**.

The results in Table (8) indicated that control positive group showed lowest significantly in serum Ca, ionized Ca and P in comparing with negative control group. Animals treated with basil powder led to significant reduction in Ca , ionized Ca and P, while The rat groups treated with basil oil showed non-significant in comparison of negative control group. On the other hand all treated groups showed highest significantly in Ca, ionized Ca and P compared with control positive group. These data are confirmed with **Holland *et al*. (1991)** who found that one hundred grams of fresh basil leaves contain 250 mg of calcium, 37 mg of phosphorus, 5.5 mg of iron, and 11 mg of magnesium. The last authors reported that decreased estrogen in females leads to increased sensitivity of the bones to the work of parathyroid hormone, which causes low bone density and bone resorption **(Bandyopadhyay *et al*., 2006; El-**

safty, 2011; Ahmed *et al*., 2012; Hassan *et al*., 2013 and Walaa Hozayen *et al*., 2016).

The statistical data in Table (9) indicated that, control positive group recorded the lowest significantly in estrogen, osteocalcin and alkaline phosphates in comparison of normal control (-ve) group. Animals treated with basil powder and oil showed lowest significantly in estrogen, osteocalcin and alkaline phosphates, while led to highest significantly in these previous parameters in comparing with the control positive group. Our results agree with **Dawson-Hughes *et al*. (2009)** who cleared that low estrogen levels lead to increased bone breakdown and reduced bone mass, which affects bone formation. Also estrogen replacement therapy is more effective in inhibition and treatment of post-menopausal osteoporosis in women **(Ashwell *et al*., 2008; Zhu *et al*., 2009; Rasheed *et al*., 2009; Hassan *et al*., 2010 and Horcajada and Offord, 2012**).

In conclusion, basil powder and oil antioxidant effects against postmenopausal osteoporosis associated with ovarian hormone deficiency and bone loss in rats. Therefore, dietary intake of basil powder and oil may be useful for female who suffer from postmenopausal.

Table (1): Chemical composition of control biscuit and biscuit with basil powder and oil.

Parameters / Samples	Moisture %	C. protien %	T. fat %	Ash %	T. carbohydrates %	C. fiber %
Control biscuit	23.93	9.84	4.59	2.47	59.17	12.02
Biscuit 10% basil powder	23.29	11.03	3.66	2.90	59.12	12.13
Biscuit 1.0 ml basil oil	23.81	10.95	4.27	2.63	58.34	11.97

Table (2): T. phenol, Flavonoids, Peroxide value and Thiobarbituric acid (TBA) of biscuits during one month storage period at room temperature.

Samples / Parameters	Control biscuit				Biscuit 10% basil powder				Biscuit 1.0 ml basil oil			
	0	10	20	30	0	10	20	30	0	10	20	30
T.phenol mg/g	1.66	1.91	2.08	2.12	2.09	2.32	2.49	2.57	2.53	2.71	2.84	2.95
Flavonoids mg/g	0.49	0.58	0.62	0.69	0.77	0.83	0.97	1.09	0.98	1.09	1.21	1.38
Peroxide value meq/kg	14.29	14.51	14.90	15.11	13.09	13.43	13.86	14.05	12.77	12.94	13.39	13.73
T.B.A Ppm	0.148	0.190	0.215	0.253	0.121	0.159	0.196	0.221	0.109	0.136	0.173	0.205

Table (3): Physical characteristics of control biscuit and biscuit with basil powder and oil.

Parameters / Samples	Weight (g)	Thickness (mm)	Diameter (mm)	Spread ratio
Control biscuit	8.6	9.3	45	4.83
Biscuit 10% basil powder	8.4	7.5	42	5.6
Biscuit 1.0 ml basil oil	8.3	8.33	41	4.92

Table (4): Sensory scores of biscuit during one month storage period at room temperature.

Samples / Parameters	Control biscuit				Biscuit 10% basil powder				Biscuit 1.0 ml basil oil			
	0	10	20	30	0	10	20	30	0	10	20	30
Color (9)	8.6	8.4	8.2	8.2	7.9	7.6	7.2	7.1	8.9	8.6	8.4	8.3
Taste (9)	8.7	8.3	8.3	7.2	8.0	7.8	7.6	6.9	8.5	8.2	7.7	7.1
Crispiness (9)	9.0	8.6	8.3	7.8	8.1	7.9	7.9	7.6	8.5	8.1	7.7	6.9
Texture (9)	8.7	8.7	8.2	7.9	8.0	8.0	7.9	7.7	8.1	8.0	7.8	7.0
Flavour (9)	8.6	8.5	8.2	7.4	8.3	8.0	7.6	7.3	8.7	8.7	8.4	7.7
Overall acceptability (9)	8.8	8.6	8.1	7.9	7.9	7.5	7.3	7.0	8.6	8.3	7.8	7.6

Table (5): Nutritional indicators in control and different treated groups.

Groups / Variables	body weight gain (g)	Food intake (g/w)	FER
Normal control	93.01 ± 8.71 ^{a}	17.54 ±1.23 ^{a}	0.067±0.008^{a}
Positive control	72.19 ±5.11 ^{c}	12.55 ±1.18 ^{b}	0.049±0.006^{c}
5% basil powder	82.86 ±7.42 ^{b}	16.44±1.24 ^{a}	0.052±0.004^{b}
10% basil powder	86.72 ±7.31 ^{b}	16.23±1.27 ^{a}	0.053±0.002^{b}
0.5ml basil oil	90.30 ±8.17 ^{ab}	17.02±1.71 ^{a}	0.053±0.002^{b}
1.0 ml basil oil	92.42 ±9.12 ^{a}	17.45±1.81 ^{a}	0.052±0.002^{b}

Mean values in each column having different superscript (a, b, c, d,..) are significantly.

Table (6): Levels of some serum lipid patterns of control and different treated groups.

Groups / Variables	TC mg/dl	TG mg/dl	HDL-C mg/dl	LDL-C mg/dl	VLDL-C mg/dl
Normal control	107.69±2.66^{e}	89.44±2.85^{d}	61.85±2.23^{a}	39.18±3.23^{e}	17.97±1.08^{d}
Positive control	161.16±8.98^{a}	109.31±6.69^{a}	50.19±±1.87^{d}	88.76±6.21^{a}	21.96±1.82^{a}
5 % basil powder	141.29±4.19^{b}	98.46±4.54^{b}	55.55±1.54^{c}	65.25±6.44^{b}	18.49±1.33^{b}
10 % basil powder	139.28±3.45^{c}	95.46±2.15^{b}	57.12±2.11^{b}	60.27±2.01^{b}	18.11±1.64^{c}
0.5 ml basil oil	128.19±3.11^{d}	93.51±±2.31^{c}	59.66±2.10^{b}	49.15±3.11^{c}	17.50±1.07^{d}
1.0 ml basil oil	115.68±3.99^{e}	90.52±2.26^{d}	60.61±2.13^{a}	44.97±3.22^{d}	16.30±1.11^{d}

Mean values in each column having different superscript (a, b, c, d,…) are significant.

Table (7): Bone mineral density and bone mineral contents of control and different treated groups.

Groups / Variables	BMD g/cm^2	BMC g/cm^2
Normal control	0.1433±0.0061 ^{a}	0.0956±0.0031 ^{a}
Positive control	0.0582±0.0041 ^{e}	0.057±0.0061 ^{f}
5 % basil powder	0.0985±0.0039 ^{d}	0.0697±0.0048 ^{e}
10% basil powder	0.1098±0.0061 ^{c}	0.0749±0.0045 ^{d}
0.5 ml basil oil	0,1371±0.0081 ^{b}	0.0853±0.0041 ^{c}
1.0 ml basil oil	0.1378±0.0091 ^{b}	0.0892±0.0053 ^{b}

Mean values in each column having different superscript (a, b, c, d,….) are significantly.

Table (8): Serum minerals parameters in control and different treated groups.

Groups / Variables	Ca (mg/dl)	Ionized Ca (mg/dl)	P (mg/dl)
Normal control	6.82±2.83^{a}	4.22±0.31^{a}	7.08±1.46^{a}
Positive control	4.19±0.22^{c}	1.64±0.49^{c}	5.28±0.54^{c}
5 % basil powder	5.25±0.44^{b}	2.45±0.54^{b}	6.07±0.31^{b}
10 % basil powder	5.98±0.55^{b}	2.65±0.57^{b}	6.53±0.45^{b}
0.5 ml basil oil	6.71±0.45^{a}	3.64±0.73^{a}	6.85±0.57^{ab}
1.0 ml basil oil	6.78±0.46^{a}	3.94±0.65^{a}	6.97±0.53^{ab}

Mean values in each column having different superscript (a, b, c, d,..) are significant.

Table (9): Serum estrogen, osteocalcin and alkaline phosphatase in control and different treated groups.

Groups / Variables	Estrogen (mg/dl)	Osteocalcin (µg/mL)	Alkaline Phosphates (U/L)
Normal control	13.84±3.11^{a}	42.18±6.48^{a}	91.21±7.31^{a}
Positive control	9.79±1.45^{d}	19.38±1.82^{d}	51.64±5.49^{d}
5 % basil powder	11.25±2.10^{c}	28.13±4.01^{c}	61.45±6.34^{c}
10 % basil powder	11.96±2.15^{b}	29.09±4.12^{c}	68.65±6.11^{c}
0.5 ml basil oil	12.49±3.05^{b}	36.52±5.01^{b}	88.64±7.13^{b}
1.0 ml basil oil	12.71±3.10^{b}	40.82±5.13^{b}	90.24±7.15^{b}

Mean values in each column having different superscript (a, b, c, d) are significant.

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تأثير مسحوق و زيت الريحان على إناث الفئران بعد انقطاع الطمث

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الملخص :

أجريت الدراسة الحالية لدراسة تأثير مسحوق و زيت الريحان على إناث الفئران بعد انقطاع الطمث وقد أجريت الدراسة على ٣٠ من إناث فئران التجارب التى قسمت الى ٦ مجموعات متساوية تحتوى كل مجموعة على ٥ فئران استخدمت المجموعة الاولى (خمسة من صغار الفئران) كفئران طبيعية تتراوح اعمارهم من ٧ الى ٩ اسابيع وتتراوح اوزانهم من٨٠ الى ٩٥ جرام وهى المجموعة الضابطة السالبة والتي تغذت على الغذاء الاساسي وباقى الفئران (٢٥ فأر) تتراوح اعمارهم من ١٩ الى ٢١ اسبوع و تتراوح اوزانهم من٢٠٠ الى ٢٠٥ جرام تم تقسيمهم الى خمس مجموعات كالاتى: المجموعة الثانية وهى المجموعة الضابطة الموجبة تغذت على الغذاء الاساسي ، المجموعتان الثالثة والرابعة تم تغذيتهم على غذاء اساسى يحتوى على مسحوق الريحان (٥ و١٠ % من الوجبة) والمجموعتان الخامسة و السادسة تم تغذيتهم على غذاء اساسى ومعاملتهما يوميا عن طريق الانبوب المعدى بزيت الريحان (٠.٥ و١.٠ مل/ كجم من وزن الجسم) على التوالى و ذلك لمدة ٨ اسابيع، وقد أظهرت النتائج ان المجموعات التى تغذت على كل من مسحوق و زيت الريحان سجلت تحسنا ملحوظ ذو دلالة احصائية فى الزيادة فى الوزن والطعام المتناول ونسبة الاستفادة من الطعام والليبوبروتينات مرتفعة الكثافة كذلك اظهرت النتائج زيادة كثافة المعادن فى عظام الفخذ ومحتوى العظام من المعادن وزيادة مستوى الكالسيوم والفسفور وهرمون الاستروجين فى السيرم بينما اظهرت النتائج انخفاض مستوى الكوليسترول والدهون الثلاثية والليبوبروتينات منخفضة الكثافة و الليبوبروتينات منخفضة الكثافة جدا بالمقارنة بالمجموعة الضابطة الموجبة. و قد أظهرت النتائج ان افضل المعاملات كانت فى كلا من المجموعة المعالجة بمسحوق الريحان (١٠%) و المجموعة المعالجة بزيت الريحان (١.٠ مل) لذلك تم إضافتهم الى البسكويت لرفع قيمته الغذائية والعلاجية ، وقد سجلت نتائج التحليل الكيميائى لعينات البسكويت ارتفاع البروتين والرماد و الالياف فى البسكويت المضاف له مسحوق الريحان كذلك سجلت النتائج ارتفاع محتوى الفينولات والفلافونيدات فى البسكويت

المضاف له زيت الريحان يليه المسحوق بالمقارنة بالكنترول فى حين سجلت النتائج انخفاض قيمة كلا من البيروكسيد والثيوباربيوتريك فى البسكويت المضاف له زيت ومسحوق الريحان بعد ثلاثين يوم من فترة التخزين فى درجة حرارة الغرفة بالمقارنة بالكنترول كما اظهرت النتائج الفيزيائية ارتفاع قيمة الانتشار النسبى فى البسكويت المضاف له مسحوق الريحان بالمقارنة بالكنترول كما اظهرت النتائج الحسية ارتفاع كل من درجة اللون والنكهة فى البسكويت المضاف له زيت الريحان بالمقارنة بالكنترول.

توصي الدراسة بتناول المخبوزات وأنواع الأطعمة المدعمة بمسحوق وزيت الريحان للحصول على فائدة غذائية وصحية للاناث بعد انقطاع الطمث لما لهم من تأثير على حيوانات التجارب.

الكلمات الاسترشادية: الريحان ، الاستروجين ، فقدان العظام ، الفئران ، البسكويت