Hypolipidimic Effects of Dried Tomato Pomace Powder on Aging Female Rats

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ABSTRACT

Tomato pomace is rich in bioactive food components, and has therapeutic properties but have a low economic value. In this paper, the effect of tomato pomace on reduce lipid profile and improve antioxidant status in aging female rats, also the potential use of tomato pomace in bread were studied. Twenty four aging female rats were divided randomly into four groups, six rats per each. First (control group), second, third and fourth group received basal diet + 0, 2.5, 5 and 10 % of dried tomato pomace (DTP) respectively for 4 weeks. Animals were sacrificed, blood samples were collected. Serum was then removed by centrifuging for analysis. Also, tomato pomace powder was used to replace part of the whole wheat flour (0%, 2.5%, 5% and 10%) in standard baladi bread. Appearance, taste, flavor, texture, compressibility, color and overall acceptability were evaluated in baladi bread. 10% dried tomato pomace group was more effective to reduce serum total lipid (T.L), triglyceride (TG), total cholesterol (TC) and atherogenic indices levels than other groups. While, antioxidant status indicators improved in DTP groups and 10% DTP had more effective. Moreover, sensory evaluation showen that all portion of DTP in bread were found acceptable by the panelists. It conclude that dried tomato pomace powder improved lipid profile levels and antioxidant status in aging female rats and it obtained good result in sensory evaluation of baladi bread.

Keywords: *Aging female rats - dried tomato pomace- Hypolipidimic effects – bread*

INTRODUCTION

Aging has been defined as natural, progressive and generalized deterioration process that occurs over time. Aging is directly related to homeostasis loss and with gradual dysfunction, that in many cases concurs with pathological situations and finally ends in death **(Wheeler and Kim, 2011; López-Otín et al., 2013).**

The principal causes of death in older people are cardiovascular diseases (CVD), stroke and chronic lung disorders. The World Health Organization (WHO) projected a scenario for 2030 in which CVD will maintain its position among the top causes of death in older adults, with females as the most vulnerable group **(Silva-Palacios et al., 2016)**. Decreasing estrogen levels during the menopausal transition have been linked to endothelial dysfunction and larger vessel diameters, markers of early adverse vascular changes **(Mendelsohn, 2002).** Therefore, decreased estrogen following the menopausal transition leaves the vasculature vulnerable to CVD risk factors, such as lipids. Lifestyle characteristics are important determinants of healthy aging. Nutrition is a pivotal constituent of a healthy lifestyle, and epidemiological evidence links diets rich in fruits and vegetables, such as the Mediterranean diet, with healthy longevity (**Bonaccio et al .,2012)**.

Tomato (Lycopersicon esculentum) is a well-known plant that belongs to Solanaceae family and it is one of the widely consumed vegetables, either fresh or industrially processed (**Aguayo et al., 2009**). In the year 2006, the average annual production of tomato in Egypt was recorded to be 7.6 million tons resulting in production of 19% as by-product during manufacturing (**FAO (2011).** Unfortunately, a great part of this by-product is lost without utilization **(Aghajanzadeh-Golshani et al., 2010)**.

Tomato pomace, as a by-product, is a mixture of tomato skin, pulp and crushed seeds that remain after the processing of tomato for juice, paste and/or ketchup **(Mirzaei-Aghsaghali et al., (2008); Nobakht and**

Safamehr (2007) and Ventura et al.,(2009)).

The dried tomato pomace has been considered as a good source of protein and natural pigments such as β- carotene and lycopene as well as a valuable source of α-tocopherol which is used as an antioxidant (**Karadas et al., 2006** and **King & Zeidler 2004**).

Tomato pomace could afford health benefits by preventing unwanted free radical induced oxidative reactions. It is necessary to consider both environmental (waste management and protection against pollution) aspects and economical aspects (extraction profitability) before the extracts from tomato residues could be commercially exploited. More research is needed to establish bioavailability **(Sladjana et al., 2012).**

Therefore, the present investigation aims to evaluate the effect of dried tomato pomace to reduce the levels of lipid profile and atherogenic indexes in aging female rats and study its application in food to utilization of it.

MATERIALS &METHODS

Materials:

Tomato pomace

Tomato pomace as a waste during the preparation of tomato juice was obtained from Edfina Company for food preservation, Alexandria, Egypt.

Animals:

Twenty four aging female Sprague Dawley rats, 18-20 months old, with an average body weight (B.W) 300 ±5g, were purchased from the Veterinary Medicine Institute, Cairo, Egypt. At the beginning of experiment, a3 ml of their blood samples were collected to determine lipids profile to make sure diagnosed with hyperlipidemia. Under normal laboratory conditions, with 12-hours light-dark cycle at 25 ± 1°C, rats were housed in cylindrical wire cages with wire bottoms. The diet was introduced to rats in special food cups to avoid scattering of food. Also, water was provided to the rats by glass tube projection through the wire cage. Food and water provided and checked daily. Rats were fed standard diet according

to AIN-93 guidelines (**Reeves et al., 1993**). All animals received care in compliance with the Egyptian rules for animal protection.

Methods:

Preparation of tomato pomace and chemical analysis:

Tomato pomace were dried in a laboratory oven dryer (Plue Pard Drying Oven, Taiwan) at 50°C milled by (Moulinex miller, France) to be a fine powder. Sample of the prepared tomato pomace was taken for estimating its chemical composition (moisture, protein, fat, ash and carbohydrates by difference) using the methods of **A.O.A.C (2012)**. Total phenolic content expressed as gallic acid equivalent (GAE) was determined by the Folin–Ciocalteu micro-method according to **Saeedeh and Asna, (2007).** Total flavonoids content expressed as quercetin equivalent (QE) was determined by the method of **Ordon *et al.*, (2006)**. β-Carotene and lycopene was determined by Kimura's method according to **Nagata and Yamashita, (1992).** Antioxidant activity of tomato pomace extract was determined by 2, 2 diphenyl-1-picrylhydrazyl (DPPH) according to **Yang et al., (2006)**.

Experimental design:

The rats were divided randomly into four groups, (6) rats per each. First (control group), second, third and fourth group received basal diet + 0, 2.5, 5 and 10 % of dried tomato pomace (DTP) respectively for 4 weeks. Animals were sacrificed under diethyl ether anesthesia. Blood samples were collected from the hepatic portal vein. The blood samples were placed in dry clean centrifuge tubes and allowed to clot for 1-2 h at room temperature. Serum was then removed by centrifuging at 1500g for 10 min. The clear supernatant serum was kept at -20°C until analysis. Red blood cells were washed three times with buffered saline (0.9% saline in 0.01 M phosphate buffer, pH 7.4). The packed cells were then suspended in an equal volume of the buffered saline and stored at -20 ^{o}C for antioxidant enzymes analysis. And Serum was carefully aspirated and transferred into clean cuvette tube and stored

frozen at -20°C for analysis according to the procedure of **(Schermer, 1967).**

Biochemical assays:

The serum triglycerides (TG), high density lipoprotein (HDL), total cholesterol (TC) and total lipids (TL) were determined according to the methods described by **Fossati and Prencipe (1982)** ; **Demacker *et al*. (1980) ; Richmound, (1973) and Covaci *et al*., (2006)** respectively. The determination of low density lipoprotein cholesterol (LDLc) and very low density lipoprotein cholesterol (VLDLc) were carried out according to the method of **Lee and Nieman (1996)** The Atherogenic ratios were calculated as follows: Atherogenic Index of Plasma (AIP) = log TG/HDLc, Cardiac risk ratio (CRR) = TC/HDLc Castelli's Risk Index (CRI) = LDLc/HDLc Atherogenic Coefficient (AC) = (TC–HDLc)/HDLc according to **Bhardwaj *et al*., (2013)** and Atherogenic fraction (AF) was calculated as the difference between TC and HDL-C according to **Aguilar et al., (2011).** Thiobirbituric acid reactive substances (TBARS) was estimated according to the methods of **Esterbauer and Cheeseman (1990)** . Superoxide dismutase (SOD) and reduced glutathione (GSH.Rd) we-re assayed according to the methods of **Misra and Fridovich (1972)** and **Beutler *et al*. (1963)** respectively. Catalase (CAT) activity was determined by measuring the decomposition of hydrogen peroxide (H2O2) at 240 nm according to the method of **Aebi (1983)**.

Preparation of bread and sensory evaluation

Balady bread was prepared by mixing 100 g of wheat flour (82% extraction), 0.5 g of active dry yeast, 1.5 g of sodium chloride, 75–80 mL of water by hand for about 6 min to form the needed dough. DTP was used to replace part of the whole wheat flour (0%,2.5, 5% and 10%) in a standard balady bread recipe The dough was left to ferment for 1 h at 30°C and 85% relative humidity, and was then divided

into 125 g pieces. The pieces were arranged on a wooden board that had been sprinkled with a fine layer of bran and were left to ferment for about 45 min at the same temperature and relative humidity. The pieces of fermented dough were flattened to be about 20-cm in diameter. The flattened loaves were proofed at 30–35°C and 85% relative humidity for 15 min and then were baked at 400–500°C for 1–2 min. The loaves were allowed to cool at room temperature for 2 h before being packed in polyethylene bags and stored at room temperature for sensory evaluation (**Eissa et al., 2007**). Samples of bread were subjected to organoleptic tests (by fifteen judges) according to **Watts *et al.*, (1989)**. Judging rang for appearance, taste, flavor, texture, compressibility, color and overall acceptability was as follow, Excellent (9-10), Very good (8 - 7), Good (5-6), Fair (3-4), Poor (1-2) and very poor (0-1).

Statistical analysis:

Results were expressed as the mean ± SD. Data for multiple variable comparisons were analyzed by one-way analysis of variance (ANOVA). For the comparison of significance between groups, Duncan's test was used as a post hoc test according to the statistical package program (**Artimage and Berry, 1987).**

RESULTS & DISCUSSION

The proximate chemical compositions and bioactive compounds of DTP presented in table (1). Tomato pomace contained 20.18% moisture, 0.18% protein, 11.33% fat, 48.82% fiber, 14.78% carbohydrate and 4.71% ash. This result came in accordance with that reported by **Elazab *et al*., (2011).**

Also, the crude protein content of tomato pomace was similar to that reported by **Taghizadeh *et al*., (2008).** Fiber content of tomato pomace was similar to result of **Chumpawadee and Pimpa, (2008)** & **shao *et al*., (2013)** which was 47.3%. In the same table, data indicated that tomato pomace antioxidant activity was

41.25%; this result was higher than the result obtained by **Vallverd Queralt *et al*., (2011). Toor and savage, (2005)** found that the skin of tomato had higher levels of antioxidant activity. In recent result, total phenolic compounds in tomato pomace were 6.40mg GAE g^{-1}. This results was in disagreeing with the given by **Sladjana *et al*., (2012)** and **Farag *et al*., (2009)**.

Toor and savage (2005) found that the skin of tomato had higher levels of total phenolices , Tomato pomace contained 0.324 QE g^{-1} flavonoids. Another study **Sladjana *et al*.,** (**2012)** investigated a higher amount of total flavonoids in tomato waste (7.62mg/g).

Also **Stewart *et al*., (2000)** reported that the majority of the flavonoids in tomato pomace present in skin. The amount of the lycopene in tomato pomace was 81.60 mg/ 100mg. The result of this study came in accordance with that reported by **Irini and Vassiliki (2011**). Also, **Sgorlon *et al*., 2006** had confirmed that tomato pomace containing 1.3% lycopene. **Toor and savage, (2005)** found that the skin of tomato had higher levels of lycopene. Interestingly, tomato pomace had a high β-Carotene amount (32.17 mg/100mg). The recent result disagree with that reported by **Huang *et al*., (2008) and Irini and Vassiliki (2011).**

The effect of adding dried tomato pomace powder on serum lipid profile in aging female rats is recorded in table (2). Rats which administrated basal diet alone (0% DTP) were high significantly ($P \leq 0.05$) than all groups in T.L, TG, TC, LDL and VLDL levels and low in HDL. **(Paolo *et al*., 1999)** confirmed the obtained result as who showed that plasma cholesterol levels increase with age, as does the incidence of coronary heart disease. While 10% dried DTP were more effective ($P \leq 0.05$) to decrease T.L, TG, TC, LDL and VLDL levels, while HDL had opposite trend. Similar trend was observed for **Elliott *et al*., (1981)** reported that 10% TP supplementation resulted in significantly higher serum cholesterol than the control diet in rats.

Elazab *et al.*, (2011) noticed that fed growing rabbits on tomato pomace inclusion diets resulted in a significant increase in plasma cholesterol concentration compared to the control group and this effect was attributed to tomato pomace level. Also recent result correlates with results reported by **Rahmatnejad *et al* .,(2009**), **Shao *et al.*, (2013a) and** (**Bajerska *et al.*, 2015)** they reported that showed that dried tomato pomace lowered plasma TC and low-density lipoprotein cholesterol (LDLC) concentrations and increased fat excretion. They suggest that protein, dietary fiber or phenolic compounds in dried tomato pomace may be responsible for plasma cholesterol decrease. Lycopene accumulates in the liver and can inhibit the activity of the rate-limiting enzyme of cholesterol biosynthesis **(Navarro-González *et al*., 2014).**

While **Shao *et al.*, (2013a)** reported that there were no significant differences of plasma TG concentration between all the tomato sample groups and their corresponding controls, and they showed that VLDL-C in DTS fed animals were also lower although not statistically significantly. Decrease plasma total lipids concentration in tomato pomace groups was attributed to increase lipid metabolism and transfer these lipids from blood to adipose tissues **(Elazab *et al.*, 2011).**

Effect of dried tomato pomace powder on atherogenic indices and HDL/TC ratio HTR% in aging female presented in table (3). The groups which administrated DTP were significantly ($p \leq 0.05$) decrease in AIP, CRR, CRI, AF and AC and increase in HTR% than the group which feed basal diet alone. More considerable reduction ($p \leq 0.05$) in AIP, CRR, CRI, AF and AC were observed in rats administrated with 10% DTP group compared to other aging female groups followed by 5% DTP group, and 2.5% DTP group. Also, the group which taken10 % DTP had more improvement in HTR% than other DTP group. Atherogenic indices are powerful indicators of the risk of heart disease the higher the value, the

higher the risk of developing Cardiovascular Disease (CVD) and vice versa **(Usoro *et al.*, 2006)**.

Bajerska *et al.*, (2015) repored that rye bread with tomato pomace lowering the atherogenic index of plasma (AIP) by 31.6%. **Shao *et al.*, (2013a)** suggested that tomato pomace by products especially dried tomato pomace has hypocholesterolemic properties and may be a food ingredient that prevents cardiovascular disease.

Table (4) summarized the effect of adding dried tomato pomace powder to aging female rats in antioxidant status. The level of SOD, CAT and GSH in 10% DTP group were significantly ($p \leq 0.05$) high when compared with the corresponding value 0% DTP group and the other aging female groups which received dried DTP , followed by 5% DTP group and 2.5% DTP group, respectively. On the other side, the mean value of MAD in 10% DTP groups was significantly ($p \leq 0.05$) lower than other groups which were 3.32±0.29, followed by 5% DTP group 4.14±0.14, followed by 2.5% DTP group 7.63±0.34 respectively. Malondialdehyde (MDA) is a degradation product generated from lipid peroxidation (oxidative degradation of polyunsaturated fatty acids in cell membrane). MDA has been extensively used as an index for lipid peroxidation and as a marker for oxidative stress **(Kubow, 1992).** Additionally, there is high oxidative stress (increased plasma level of malondialdehyde, MDA) as well as decreased activity of antioxidant enzymes, especially superoxide dismutase (SOD) **(Aluko and Udenigwe 2012). Bose and Agrawal, (2007)** confirmed the obtained result as **who** reported that lycopene decreased liped peroxidation in cardiovascular patients. GSH is one of the essential compounds for maintaining cell integrity participation in the cell metabolism. This result may occur because the accumulation of oxidized proteins during aging is most likely linked to an age-related decline of antioxidant enzyme activity, whereas lipid peroxidation is less sensitive to the

aging process **(Tian *and* Wei 1998).** Results consistently show improved antioxidant status with tomato products consumption **(Kucuk *et al.,* 2002).**

Elazab *et al.,* (2011) reported that lycopene from tomato reduced MAD but contrast increased antioxidant enzymes like GSH and SOD .Also , lycopene decreased lipid peroxidation in cardiovascular patients according to **Bose & Agrawal ,2007.** This result may occur because the accumulation of oxidized protein during aging is the most likely linked to an age-related decline of antioxidant enzyme activity, whereas lipid peroxidation is less sensitive to the aging process according to **Tian and Wei (1998).**

Also, **Sgorlon *et al.,* (2006)** had confirmed that tomato pomace was able to counterbalance oxidative stress in sheep.

Data given in **table (5)** showed the effect of dried tomato pomace powder on weights change of aging female rats. No significant ($P > 0.05$) difference in Initial body weights between all group. 10% dried DTP group had a lower final body weight than all other DTP groups and the group which received basal diet alone (control group). Body weight gain was higher in control group than that which administrated DTP group. But, 10% DTP group showed a reduction of 14.7 % in body weight gain. This finding came in accordance with that reported by **Sayed and Abdel-Azeem (2009)** who indicated the presence of higher daily gains for rabbits fed the diet contained 20% dried tomato pomace; while rabbits fed on the 30% dried tomato pomace level recorded the lowest value of daily gain. However the previous study by **Abd El-Razik (1996)** reported that there were no significant differences in live body weight, total or daily weight gain between experimental rabbit groups feed diets containing 0, 5, 10% tomato pomace for 8 weeks.

Similarly, **Shao *et al.,* (2013)** observed that the tomato pomace displayed significantly higher body weight gain compared to its control containing the same high level (25%) of dietary fiber

(P < 0.05)**.** These effects of DTP on reducing body weight may be due to high content of fiber in tomato pomace**.**

Sensory evaluation of baladi breads prepared with dried tomato pomace powder portions table (6). There were significant (P ≤0.05) decrease in appearance and taste in bread prepared with DTP portion (2.5, 5, and 10%) which was similar compared with control bread. In flavor of bread which prepared with 0, 2.5 and 5% DTP were similar and were significant (P ≤0.05) increase than bread which prepared with 10% DTP. Color in bread which prepared with 2.5% DTP was non significantly with 0% DTP (control) and there increase (P ≤0.05) than other DTP bread. In the same table, no significant (p>0.05) differences were observed in texture, compressibility and overall acceptability of breads prepared with DTP portion (0, 2.5, 5, and 10%). Similar trend was observed by **Sik and Topkaya,(2016),** who studied that use of tomato pomace in crackers and the crackers were liked statistically equally by the panelists.

Also, **Bhat and Ahsan, (2015)** added different levels (0, 5, 10, 15, 20 and 25%) of tomato pomace powder to cookies. Sensory evaluation revealed that overall desirability scores were not significantly different between control and tomato pomace powder incorporated cookies. The cookies up to 5% substitution of powder were found acceptable by the consumer

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Table (1): Chemical composition and bioactive compounds of tomato pomace

Parameters	Tomato Pomace
Moisture%	20.82± 1.15
Ash%	4.71± 0.05
Protein%	0.18± 0.06
Fat%	11.33± 0.58
Fiber%	48.82± 0.46
Carbohydrate%	14.78± 0.18
Antioxidant activity %	41.25± 0.67
Total phenolic (mg GAE. g^{-1})	6.40 ±1
Total flavonoid (mg QE. g^{-1})	0.324± 0.00
lycopene(mg/100mg)	81.60± 0.38
B-Carotene (mg/100mg)	32.17± 1.01

Each value in the table is the mean ± standard deviation of three replicates.

Table (2): Effect of DTP on serum lipid profile in aging female rats

Groups / Parameters	Aging female rats			
	0% DTP (control)	2.5% DTP	5% DTP	10% DTP
T. L. (mg/dl)	451.12^{a}±2.98	396.23^{b}±2.48	315.27^{c}±1.96	262.16^{d}±2.37
T. G. (mg/dl)	175.36^{a}±1.64	146.77^{b}± 1.66	109.5^{c}±1.23	90.84^{d}±1.54
T. C. (mg/dl)	193.22^{a}±1.15	178.17^{b}±0.60	150.14^{c}±0.43	124.88^{d}±0.37
HDL (mg/dl)	16.86^{d}±0.66	21.17^{c}±0.10	24.23^{b}±0.16	28.84^{a}±0.29
LDL (mg/dl)	141.2^{a}±1.28	127.64^{b}±0.54	104.01^{c}±0.35	77.87^{d}±0.09
VLDL(mg/dl)	35.07^{a}±0.33	29.35^{b}±0.33	21.78^{c}±0.45	18.15^{d}±0.32

Data are expressed as mean ± SD. Values within a row having different superscripts are significantly different ($p \leq 0.05$); where the small letters indicate significant among dietary treatment groups as indicated by one-way ANOVA followed by Duncan's multiple range test ($a > b > c > d > e$).

Table (3): Effect of DTP on atherogenic indices and HTR% in aging female rats

groups / Parameters	Aging female rats			
	0% DTP (control)	2.5% DTP	5% DTP	10% DTP
AIP (mg/dl)	1.01^{a}±0.02	0.83^{b}±0.01	0.65^{c}±0.01	0.49^{d}±0.01
CRR	11.47^{a}±0.45	7.97^{b}± 0.97	6.16^{c}±0.84	4.31^{d}±0.03
CRI (mg/dl)	8.38^{a}±0.38	6.02^{b}±0.03	4.28^{c}±0.03	2.69^{d}±0.2
AF (mg/dl)	51.93^{a} ±0.94	50.53^{b}±0.36	46.14^{c}±0.20	47.01^{d}±0.42
AC (mg/dl)	10.47^{a}±0.45	7.40^{b}±0.05	5.19^{c}±0.05	3.32^{d}±0.04
HTR%	0.08^{d}±0.00	0.11^{c}±0.01	0.16^{b}±0.00	0.23^{a}±0.00

Data are expressed as mean ± SD. Values within a row having different superscripts are significantly different ($p \leq 0.05$); where the small letters indicate significant among dietary treatment groups as indicated by one-way ANOVA followed by Duncan's multiple range test ($a > b > c > d > e$)

Table (4) : :Effect of DTP on antioxidant status in aging female rats .

groups / Parameters	Aging female rats			
	0% DTP (control)	2.5% DTP	5% DTP	10% DTP
SOD(u/ml)	190.30^{d}±0.70	210.45^{c}±0.37	227.76^{b}±0.31	235.41^{a}±0.82
CAT(U/L)	16.95^{c}± 1.46	17.92^{c}± 1.23	20.37^{b}± 1.70	23.65^{a}± 1.35
GSH(U/L)	0.18^{d}± 0.01	0.20^{c}± 0.01	0.28^{b}± 0.01	0.34^{a}± 0.14
MAD (nmol/ml)	8.45^{a}±0.30	7.63^{b}±0.34	4.14^{c}±0.14	3.32^{d}±0.29

Data are expressed as mean ± SD. Values within a row having different superscripts are significantly different ($p \leq 0.05$); where the small letters indicate significant among dietary treatment groups as indicated by one-way ANOVA followed by Duncan's multiple range test ($a > b > c > d > e$)

Table (5): Effect of DTP on weights change of aging female rats .

groups / Parameters	Aging female rats			
	0% DTP (control)	2.5% DTP	5% DTP	10% DTP
Initial weight	304.0^{a} ±1.20	303.6^{a}±0.89	303.4^{a}± 1.54	303.8^{a}± 1.30
Final weight	358.2^{a}±1.92	321.8^{b}±4.32	287.6^{c}±.6.50	259.2^{d}±2.7
Changes	54.2	18.2	- 15.8	- 44.6

Data are expressed as mean ± SD. Values within a row having different superscripts are significantly different ($p \leq 0.05$); where the small letters indicate significant among dietary treatment groups as indicated by one-way ANOVA followed by Duncan's multiple range test ($a > b > c > d > e$)

Table (6): Sensory evaluation of breads prepared with dried tomato pomace portions.

Bread Parameters	Dried tomato pomace portions			
	0%	2.5%	5%	10%
Appearance	$9.12^{a} \pm 0.35$	$7.75^{b} \pm 0.46$	$7.62^{b} \pm 0.51$	$7.50^{b} \pm 0.53$
Taste	$9.37^{a} \pm 0.35$	$8.31^{b} \pm 0.59$	$8.18^{b} \pm 0.37$	$8.0^{b} \pm 0.27$
Flavor	$9.44^{a} \pm 0.42$	$9.37^{a} \pm 0.44$	$9.31^{a} \pm 0.37$	$8.0^{b} \pm 0.71$
Texture	$9.63^{a} \pm 0.44$	$9.38^{a} \pm 0.35$	$9.75^{a} \pm 0.27$	$9.38^{a} \pm 0.35$
compressibility	$9.63^{a} \pm 0.35$	$9.43^{a} \pm 0.41$	$9.62^{a} \pm 0.44$	$9.38^{a} \pm 0.44$
Color	$9.38^{a} \pm 0.43$	$9.18^{a} \pm 0.29$	$7.81^{b} \pm 0.25$	$5.93^{c} \pm 0.18$
Overall acceptability	$9.50^{a} \pm 0.46$	$9.25^{a} \pm 0.27$	$9.19^{a} \pm 0.29$	$9.18^{a} \pm 0.29$

Data are expressed as mean ± SD. Values within a row having different superscripts are significantly different ($p \leq 0.05$); where the small letters indicate significant among dietary treatment groups as indicated by one-way ANOVA followed by Duncan's multiple range test ($a > b > c > d > e$)

التأثير الخافض للدهون الدم لمسحوق مخلفات الطماطم المجففة على إناث الجرذان المسنة

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الملخص العربي

مخلفات الطماطم غنية بالمركبات الفعالة و تمتلك خصائص علاجية على الرغم من قيمتها الاقتصادية المنخفضة، فى هذا البحث، تم دراسة تأثير مخلفات الطماطم على خفض دهون الدم و تحسين الحالة التاكسدية على اثاث انجرذان المسنة بالاضافة الى امكانيه استخدامها فى الخبز . تم تقسيم اربعة و عشرون من الإناث المسنة عشوائيا إلى أربع مجموعات، ستة جرذان لكل مجموعة. المجموعة الاولى (المجموعة الضابطة) ، المجموعة الثانية ، الثالثة، الرابعة تغذت على الوجبة الاساسية مضاف اليها ٠، ٢,٥، ٥، ١٠% من مسحوق مخلفات الطماطم المجففة على التوالى لمدة اربعة اسابيع . تم جمع عينات الدم ، ثم ازالة المصل بواسطة الطرد المركزى لتحليله. ايضا، تم استخدام مسحوق مخلفات الطماطم المجففة ليحل محل جزء من دقيق القمح الكامل بنسبة (٠٪، ٢,٥٪، ٥٪ و ١٠٪) في الخبز البلدي .و تقييم المظهر والطعم والنكهة، والملمس، الانضغاطية واللون والقبول العام في الخبز البلدى .وكان مجموعة الفئران التى تغذت على ١٠% من مسحوق مخلفات الطماطم المجففة أكثر فعالية فى خفض من الدهون الكلية في الدم (T.L)، الجليسريدات الثلاثية (TG) ، الكولسترول الكلي و مؤشرات تصلب الشرايين عن المجموعات الأخرى . فى حين تحسنت مؤشرات الحالة التأكسدية فى مجموعات الجرذان التى تغذت على مخافات الطماطم و كانت مجموعة الـ ١٠% مخلفات الطماطم الاكثر فاعلية .كما اظهر التقييم الحسى للخبز ان جميع نسب مخلفات الطماطم المضافة للخبز اعطت قبولا من قبل المحكمين . و كانت الخلاصة ان مسحوق مخلفات الطماطم المجففة ادى الى تحسين دهون الدم و الحالة التأكسدية عند إناث الجرذان المسنة كما اظهر التقييم الحسى للخبز المضاف اليه مسحوق مخلفات الطماطم قبولا لدى المحكمين .

كلمات البحث: *اناث الجرذان المسنة – مخلفات الطماطم المجففة – دهون الدم – الخبز .*