Effect of Okra Pods (*Abelmoschus esculentus*) and Their Head on Hypercholesterolemia in Rats

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Abstract

This study looked at how okra pods and their heads affected hypercholesterolemic rat's lipid profiles for eight weeks. Forty-eight adult male rats were divided into two main groups. The first main group (six rats) were fed a regular diet and used (-ve control group). The second main group of 42 rats, fed on a Hypercholesterolemic diet to induce hypercholesterolemia for 42 days, then was divided into six subgroups as follows: Subgroup (1) was fed a Hypercholesterolemic diet and used as a positive control group. Subgroups (2,3,4,5,6 and 7) were given Hypercholesterolemic diets that included supplements of 2.5% and 5% powder of okra head, okra and okra with head per kg of basal diet, respectively. According to the obtained findings, liver enzymes, kidney functions and lipid profile were found to be significantly decreased ($P \leq 0.05$) while HDL-C was noticeably increased by okra head, okra and okra with head at the tested levels as compared to the positive control group. Furthermore, significantly increased in antioxidant enzymes (SOD and CAT) while, a decrease in MDA by okra head, okra and okra with head supplementation at the tested levels in hypercholesterolemic rats. In conclusion, okra pods and its head significantly reduced cholesterol levels while also improving liver enzymes, kidney functions and antioxidant enzyme. Therefore, okra pods and their heads may be recommended for hypercholesterolemic patients.

Keywords: Okra Pods, Okra Head, Hypocholesteremia, Lipid profile, Antioxidant status.

INTRODUCTION

Hyperlipidemia is a group of conditions that leads to elevated levels of lipids in the bloodstream, such as triglycerides (TG), cholesterol and low-density lipoprotein (LDL) increases, or the level of high-density lipoprotein (HDL) decreases in the blood. Hyperlipidemia is becoming a major health problem in the world recently, even in humans **(Karam *et al*., 2019)**. The American Heart Association defines hypercholesterolemia as a total blood cholesterol content of 240 mg/dl or above. It is a significant health condition that affects people all over the world. About 13 % of people aged 20 and above in the United States had elevated total cholesterol **(Soslowsky and Fryhofer, 2016)**. Unhealthy dietary habits, coupled with a lack of physical activity, can increase plasma lipid levels, called hyperlipidemia **(WHO, 2017)**.

Hypercholesterolemia causes cardiovascular disease and accounts for one-third of all mortalities globally. Synthetic hypercholesterolemic medicines have increasingly declined in popularity as a result of their associated adverse effects and the emergence of treatment resistance **(Jørgensen *et al*., 2013)**. Consumption of vegetables that contain flavonoids and are rich in fiber can reduce cholesterol levels by increasing the excretion of bile **(John and Brunzell , 2007)**.

One of the vegetables that have high fiber content and flavonoids is okra (**Axe, 2011)**. Okra (*Abelmoschus esculentus L*.) is routinely called lady's finger around the world, belonging to the *Malvaceae* family, is an annual plant that grows wildly in many countries worldwide **(Amin, 2011)**. Okra is considered a valuable crop due to the multiple functions of its leaves, buds, flowers, pods, stems, and seeds in traditional and modern medicines **(Mihretu, 2014)**. The components of okra are mainly carbohydrates, minerals, and vitamins, whereas it is also rich in bioactive ingredients, such as flavones, alkaloids, pectin,

polysaccharides, and linoleic acid **(Durazzo *et al*., 2019)**. Modern pharmacological effects of okra include antioxidant, anti-inflammatory, immunomodulatory, gastroprotective, neuroprotective, lipid lowering and antidiabetic effects **(Esmaeilzadeh *et al*., 2020)**.

Some studies have revealed that okra can reduce serum TC, TG, and LDL and increase HDL levels **(Chukwuma *et al*., 2018)**. For example, in one study, okra powder treatment in diabetic rats induced by HFD/STZ could extremely improve lipid disturbances. Okra particularly lowered serum TG and TC levels in diabetic rats without changing in the level of HDL-C **(Erfani -Majd *et al*., 2018)**. Another study showed that 8 weeks treatment by okra powder (1 and 2%) can lower total lipids, TC, and TG levels in HFD fed rats. The high amounts of okra fibers are able to bind to bile acids which led to decrease TC through interfering with bile acids reabsorption **(Wang *et al*., 2014)**. It has been suggested that 6-week treatment with dry okra aqueous seed extract (0.5 g/kg) can reduce serum total cholesterol in hypercholesterolemic rabbits through the activation of α-hydroxylase which increased the conversion of cholesterol to bile acids in the liver **(Kzar *et al*., 2019)**.

Aim of the Study

Therefore, this study was conducted to investigate the potential effects of okra and okra head powder on Hypercholesterolemia in rats

Materials and methods

Materials

Plant: Fresh okra pods were purchased from local markets.

Chemicals: The reagent kits for blood analysis were purchased from Gama Trade Company for Chemical, Cairo, Egypt. Casein, vitamins, minerals,

cellulose, cholesterol and bile salt were purchased from the El-Gomhoria Company in Cairo, Egypt.

Kits were purchased from Gama Trade Company for Chemicals, Cairo, Egypt.

Animals: Forty- eight adult male rats **(**Sprague Dawley strain), weighing about 180±10 g b.wt. were obtained from the Laboratory Animal Colony, Helwan, Egypt.

Methods:

Preparation of the Plant Material:

To make dried okra, the pods will be washed and prepared by cutting off the ends. Cut the pods into 1/4-inch rounds or 1-inch pieces, and place them in a single layer on a dehydrator tray. Dehydrate at125°F for 4-8 hours. When crispy and dry, remove from the dehydrator and cool to room temperature. The okra head will be collected, cleaned with passing water, dried at 60 ℃ in a hot-air oven until moisture content is less than 5%, and ground into fine powder using a multi-function disintegrator (WF-20B). The acquired powder was kept in an an airtight container at 4 ℃ until use.

Experimental animal and diet: The experimental animals were done using (N=48) male rats, with body weights 180 ±10 g. The animals were kept in good circumstances in "The Postgraduate Lab of the Faculty of Home Economics, Helwan University". They were kept in standard cages at room temperature (25 ± 3 ℃) with a 12-hour dark/ light cycle. They were given a basic diet **(Reeves *et al*., 1993)** for seven days as an acclimatization period.

Inducing hypercholesterolemia in rats:

The hypercholesterolemic diet was adapted from Reeves et al. (1993) with modifications, including 14% casein, 5% cellulose, 1% vitamin mix, 10% sucrose, 3.5% mineral mix, 0.25% choline bitartrate, 4% corn oil, 0.18% l-cystine, and starch as the remainder, plus 1% cholesterol and 0.25% bile salt to induce hypercholesterolemia in rats (Pandya et al., 2006).

Biological study:

The experimental animals were done using (N=48) male rats, with body weight 180 ±10 g and were housed in well-aerated wire cages. After the adaptation period, the rats were divided into six groups, (6 rats each) as follows:

Group I: (control negative) were fed on a basal diet only.

Group II (n=42) was fed a hypercholesterolemic diet (basal diet with 1% cholesterol and 0.25% bile salt) and divided into subgroups: Subgroup 1 (positive control) received the hypercholesterolemic diet with 15% beef tallow; Subgroups 2 and 3 received the hypercholesterolemic diet supplemented with 2.5% and 5% powdered okra head per kg diet, respectively; Subgroups 4 and 5 were given the hypercholesterolemic diet with 2.5% and 5% powdered okra per kg of diet; and Subgroups 7 and 8 received 2.5% and 5% powdered okra with head per kg of diet.

At the end of the experimental period (6 weeks) rats were fasted over night before sacrificing, blood was collected and then centrifuged. Serum was separated and stored at 200 °C until analysis.

Biological Evaluation:

Feed intake was recorded daily and animals were weighed at the beginning and twice a week throughout the experimental period. Body weight gain and feed efficiency ratio were calculated at the end of the experiment according to the method of **Chapman *et al*., (1959),** using the following equations:

$$\text{BWG\%} = \frac{\text{Final body weight} - \text{Initial body weight}}{\text{Initial body weight}} \times 100$$

FER= Body weight gain (g) / Feed intake (g)

Blood Collection and Serum Separation:

At the end of the experimental period (42 days), rats were fasted overnight before scarifying and blood samples were collected from each rat and centrifuged at 3000 rpm for 15 min to obtain the serum for biochemical analysis.

Biochemical analysis:

Serum total cholesterol (TC), triglycerides (TG), and high-density lipoprotein cholesterol (HDL-c) were measured according to the methods of **Allain (1974), Fassati and Prencipe (1982), and Albers *et al.*, (1983),** respectively, while low-density lipoprotein (LDL-c) and very low-density lipoprotein (VLDL-c) were calculated using the **Friedewald *et al.*, (1972)** formula: LDL-c = TC - [HDL-c + (TG/5)] and VLDL-c = TG/5. Serum aspartate aminotransferase (AST) and alanine aminotransferase (ALT) were measured following **Bergmeyer *et al.*, (1978)**, and serum alkaline phosphatase (ALP) was determined using **Belfield and Goldberg (1971)**. Serum urea, uric acid, and creatinine were assessed according to **Patton and Crouch (1977) and Murray (1984).** Lipid peroxidation was measured by calculating plasma malondialdehyde (MDA) levels, as per **Draper and Hadley (1990)**, and superoxide dismutase (SOD) activity was evaluated following **Spitz and Oberley (1989)**, with catalase (CAT) also measured.

Statistical analysis:

All data obtained results were analyzed using Statistical Package for the Social Sciences (SPSS) for Windows, version 20 (SPSS Inc., Chicago, IL,

USA). Collected data were presented as mean ± standard deviation (SD). Analysis of Variance (ANOVA) test were used for determining the significances among different groups according **Sendecor and Cochron (1989)**. All differences will be considered significant if P-values were ($P< 0.05$).

Results and Discussion

The effect of okra pods and their heads on the body weight status in hypercholesterolemic rats was illustrated in **Table (1)**. There were no significant differences in initial body weight IBW among all treated groups. It was observed that hypercholesterolemic rats had a significant increase in final body weight FBW compared to the healthy rats. On the other hand, final body weight (FBW), body weight gain percentage (BWG%), and feed efficiency ratio (FER) were significantly lower with okra with head compared to okra head or okra alone. FBW by okra with head in the concentration of 5 % was significantly lower (224.81±1.01) than okra head or okra (235.60±1.43 or 230.40±1.36), respectively. The mean values of feed intake were seen to be lower in the groups consumed okra head, okra and okra with head. No significant difference in and FER among the treated Groups except groups of rats which treated with the low and high levels of okra head. The high fat diet (HFD) proved successful in causing obesity; rats on the HFD had significantly higher body weights. It is well known that high-fat diets increase body weight and visceral fat deposition, and such findings have previously been published **(El-Soadaa and Negm 2019** and **Negm, 2023)**.

Our results agree with, **Zhang *et al*., (2020)** who also reported that supplementation with okra powder for 12 weeks inhibited weight gain caused by HFD. **Alblihd *et al*., (2023)** found that administering okra pod extract after the onset of diabetes led to maintaining body weight, which is consistent with

previous reports **(Liu *et al.*, 2018)**. Importantly, the flavonoids in okra have antioxidant properties that prevent beta cell damage. Although the results about the okra on body weight and body fat are inconsistent, some possible mechanisms have been proposed in previous studies. First, okra is reported to be a rich source of fibers that can delay gastric emptying and cause a full feeling **(De Rosa *et al.*, 2010)**. Second, bioactive polysaccharides of okra and flavonoids involved in weight management **(Durazzo *et al.*, 2019)**. According to **Nikpayam *et al.*, (2022)** observed that okra had a significant effect neither on appetite score nor on food intake, compared to the placebo group. In line with our results, **Fawzy, (2019)** showed that the amount of feed intake was highest in okra.

Table (1): Effect of Okra Pods and its Head on Initial body weight (IBW), Final body weight (FBW), feed intake (FI) and body weight gain % (BWG) in hypercholesterolemic rats

Parameters / Groups	IBW g	FBW g	FI g/d/rat	BWG g	BWG %	FER
Control (-Ve)	185.20±1.49a	233.40±1.43bc	**21**	48.20±0.37cd	26.03±0.33cd	0.054±0.001b
Control (+Ve) HCD	184.21±1.73a	242.40±1.60a	**22**	58.22±0.66a	31.60±0.45a	0.063±0.001a
2.5% Okra Head	182.60±1.50a	236.40±1.35ab	**21.5**	53.81±0.58b	29.49±0.59ab	0.059±0.002a
5% Okra Head	184.80±1.52a	235.60±1.43abc	**20**	50.70±0.48c	27.50±0.41bc	0.060±0.000a
2.5% Okra	186.00±1.14a	232.80±1.86bcd	**20.5**	46.85±0.63de	25.17±0.43d	0.054±0.001b
5% Okra	186.20±1.62a	230.40±1.36bcd	**20**	44.25±0.55ef	23.75±0.47de	0.052±0.001b
2.5% Okra with Head	185.60±1.63a	227.80±1.93cd	**19.5**	42.21±0.48f	22.74±0.23ef	0.051±0.002b
5% Okra with Head	186.20±1.86a	224.81±1.01d	**18**	38.60±0.44g	20.73±0.11f	0.051±0.001b

Data are expressed as mean ± SE. Means with different superscript letters in the column are significantly differences at ($P < 0.05$).

The effect of okra pods and their heads on lipid profiles in hypercholesterolemic rats was shown in **Table (2)**. The lipid profile

investigation showed that okra pods and its head were found to have a significant effect on the lipid parameters while TC, TG, VLDL-C, and LDL-C were significantly decreased and HDL-C was significantly increased. Okra with a head concentration of 5% was found to have a significant effect on the lipid parameters as compared to the control positive group (172.01±0.84, 125.46±0.69, 123.20±0.88, and 25.09±0.13), respectively while, HDL-C was significantly increased (35.19±0.22) by okra with a head 5% compared to okra head and okra 2.5 or 5%, as compared to the control positive group (23.72±0.47). The best hyperlipidemia effect was obtained by using the okra with head 5%.

Our results are in agreement with **Majd *et al*., (2018)** and **Nguekouo *et al*., (2018)** who reported that there was a significant decrease in the level of TG, TC and LDL in rats treated by okra for 28 days. They suggested that this plant possesses an effective ability to improve dyslipidemia in rats. In another study, **Fawzy, (2019)** and **Moradi *et al*., (2020)** reported that 8 weeks of okra consumption led to a substantial reduction in serum TC, TG, LDL-c and VLDL-c but increased HDL-c levels. **Khan *et al*., (2020)** Showed a 30% significant reduction of serum LDL cholesterol levels in rats after intake of dried okra seed powder at a dose of 250 and 500mg/kg body weight of rats for 42 days. The results are corroborated by the study of **Tavakolizadeh *et al*., (2023)** and **Afsharmanesh *et al*., (2024)** found that the consumption of okra effectively improved the lipid profile (TC, LDL-C, and HDL-C). **Fouda and Mohamed, (2024)** showed that okra mucilage and flesh significantly reduced cholesterol.

Table (2): Effect of Okra Pods and its Head on Lipid profile in hypercholesterolemic rats

Parameters / Groups	TC mg/dl	TG mg/dl	HDL-c mg/dl	LDL-c mg/dl	VLDL-c mg/dl
Control (-Ve)	153.80±0.86e	92.85±0.37g	37.94±0.82a	97.29±0.41f	18.57±0.17g
Control (+Ve) HCD	172.01±0.84a	125.46±0.69a	23.72±0.47f	123.20±0.88a	25.09±0.13a
2.5% Okra Head	168.01±0.75ab	119.58±0.64b	25.93±0.22df	118.16±0.54b	23.91±0.12b
5% Okra Head	166.47±0.73bc	114.22±0.52c	27.84±0.54de	115.78±0.39bc	22.84±0.10c
2.5% Okra	163.70±0.35cd	108.80±0.68d	29.21±0.34d	112.72±0.38c	21.76±0.13d
5% Okra	161.61±0.77d	101.26±0.83e	32.17±0.35c	109.18±0.49d	20.25±0.16e
2.5% Okra with Head	159.56±0.74d	97.35±0.29f	33.60±0.39bc	106.48±0.71d	19.47±0.15f
5% Okra with Head	155.04±0.86e	95.81±0.37fg	35.19±0.22b	100.69±0.68e	19.16±0.17fg

Data are expressed as mean ± SE.

Means with different superscript letters in the column are significantly differences at ($P < 0.05$).

The effect of okra pods and their heads on serum liver functions in hypercholesterolemic rats were shown in **Table (3)**. It was observed that, the supplementation with okra head or okra or okra with head significantly decreased the liver function (ALT, AST, and ALP) compared to the control positive group. Moreover, there were a significant difference among all the treated groups for AST, ALT and ALP. The highest liver function improvement was observed in the group fed on okra with head5%.

Our results are in agreement with, **Afsharmanesh *et al*., (2024)** who found that the consumption of okra effectively improved certain serum parameters (ALT, and AST). **Aleissa *et al*., (2022)** described that okra consumption for 30 days had favorable effects on liver function markers in streptozotocin-induced diabetes in rat models. **Wahyuningsih *et al*., (2021)** showed that okra pods decreased significantly for the serum biochemical parameters of liver damage (ALT, AST and ALP). It is an antioxidant and

hepatoprotective agent to protect the liver. These results may show that the flavonoid compounds from okra earlier described by **Anjani *et al*., (2018)** restored the normal activities of the enzymes at the highest dose (100 mg/kg BW). The results are corroborated by the study of **Hu *et al*., (2014)**, where the administration of various doses of ethanol and methanol extracts of okra caused a decrease in the activities of liver enzymes in carbon tetrachloride- (CCl4-) induced oxidative stress. **Nguekouo *et al*., (2018)** also observed a substantial decline in the serum levels of ALT in T2DM rats treated with okra for 28 days.

Table (3): Effect of Okra Pods and its Head on Liver function in hypercholesterolemic rats

Parameters / Groups	AST u /L	ALT u/L	ALP mg/dL
Control (-Ve)	20.42±0.67f	37.53±0.30g	116.58±0.69f
Control (+Ve) HCD	48.98±0.33a	95.33±0.59a	169.38±0.38a
2.5% Okra Head	41.38±0.42b	81.93±0.50b	165.18±0.92a
5% Okra Head	38.38±0.31bc	71.35±0.67c	162.98±0.98a
2.5% Okra	36.58±0.66c	67.13±0.88d	155.78±0.93b
5% Okra	30.78±0.40d	63.93±0.57de	144.18±0.56c
2.5% Okra with Head	27.98±0.45de	61.37±0.34e	135.38±0.89d
5% Okra with Head	25.78±0.83e	52.95±0.64f	125.38±0.76e

Data are expressed as mean ± SE.

Means with different superscript letters in the column are significantly differences at ($P < 0.05$).

Table (4) showed the effect of okra pods and their heads on serum kidney functions in hypercholesterolemic rats. It was observed that, the supplementation with okra head or okra or okra with head significantly decreased the kidney function (urea, uric acid, and creatinine) compared to the control positive group. Moreover there was no significant difference between the two treated groups okra with head either in the concentration of 2.5 or 5 % for urea, uric acid, and creatinine. The highest kidney function improvement

was observed at the group fed on okra with head 5%. Our results are in agreement with, **Afsharmanesh *et al.*, (2024)** found that the consumption of okra effectively improved uric acid related to kidney health in pre-diabetic participants. Another study on diabetic rats showed that an 8-week administration of okra powder could significantly improve renal function in T2DM rats **(Liao *et al.*, 2019)**. **Nguekouo *et al.*, (2018)** also observed a substantial decline in the serum levels of uric acid, and creatinine in rats treated with okra for 28 days.

Table (4): Effect of Okra Pods and its Head on Kidney function in hypercholesterolemic rats

Parameters / Groups	Urea Nitrogen mg/dl	Uric Acid mg/dl	Creatinine mg/dl
Control (-Ve)	23.32±0.38f	2.78±0.05e	0.67±0.03f
Control (+Ve) HCD	48.57±0.32a	5.84±0.31a	1.70±0.01a
2.5% Okra Head	43.14±0.56b	4.82±0.25b	1.50±0.02b
5% Okra Head	36.05±0.45d	4.34±0.07bc	1.33±0.01c
2.5% Okra	39.48±0.59c	3.84±0.07cd	1.40±0.02bc
5% Okra	33.97±0.89d	3.32±0.09de	1.16±0.01d
2.5% Okra with Head	28.21±0.55e	2.96±0.01e	0.96±0.02e
5% Okra with Head	26.41±0.33e	2.74±0.06e	0.92±0.02e

Data are expressed as mean ± SE.

Means with different superscript letters in the column are significantly differences at ($P < 0.05$).

Table (5) showed the effect of okra pods and their heads on antioxidant enzymes in hypercholesterolemic rats. Results illustrated that the positive control group had a significant increase ($P<0.05$) the mean value of serum MDA but caused a decrease in the level of SOD and CAT compared to the negative control group. The supplementation with okra head or okra or okra with head significantly decreased ($P<0.05$) the mean level of serum MAD but increased significantly serum SOD and CAT compared to the positive control group. There

was no significant difference in serum MDA between groups treated with 2.5% and 5% of okra. Moreover, there was no significant difference in serum SOD and CAT between two treated groups (2,5% and 5%) of okra with head . The best results for the concentrations of MDA, SOD and CAT were recorded at the group fed on HCD diet supplemented with 5% of okra with head.

Our results are in agreement with, **Wahyuningsih *et al*., (2021)** showed that the activities of CAT and SOD were significantly increased in mice given okra extract. **Wahyuningsih *et al*., (2020)** showed that okra pod methanol extract (OPME) exerted hepatoprotective effects by lowering MDA. It also improved SOD and CAT levels and recovered damaged liver tissue to its normal state. The optimal dose of OPME was 50-100 mg/kg BW. In addition, another study reported that seeds and peels of okra pods could increase levels of enzyme antioxidants (SOD), and also have reduced levels of (MDA) in rat models of diabetes caused by streptozotocin **(Elkhalifa *et al*., 2021)**.

Phoswa and Mokgalaboni, (2023) showed that *Abelmoschus esculentus* treatment in rodent models of diabetes significantly increases CAT activity while reducing MDA. *A. esculentus* potential to reduce ROS is associated with its high polyphenols, flavonoids, and vitamin C content as they scavenge free radical molecules, thus alleviating oxidative stress **(Romdhane *et al*., 2020**). It was explained to support these results that okra pods have flavonoid compounds such as anthocyanin, quercetin and catechin that act as antioxidants which scavenge free radicals **(Elkhalifa *et al*., 2021, and Nwankwo *et al*., 2021)**.

Table (5): Effect of Okra Pods and its Head on antioxidants enzymes in hypercholesterolemic rats

Parameters / Groups	MDA ng/mL	SOD U/mL	CAT Pg/mL
Control (-Ve)	113.83±0.86g	0.77±0.07a	18.97±0.23a
Control (+Ve) HCD	287.98±1.59a	0.54±0.07e	7.60±0.21f
2.5% Okra Head	241.81±1.48b	0.57±0.03e	8.16±0.27ef
5% Okra Head	224.41±1.60c	0.61±0.02d	9.75±0.19de
2.5% Okra	214.04±1.53cd	0.67±0.03c	10.96±0.46d
5% Okra	206.19±1.67d	0.71±0.06b	13.04±0.25c
2.5% Okra with Head	187.34±1.71e	0.73±0.05ab	15.45±0.40b
5% Okra with Head	154.29±1.82f	0.75±0.03ab	16.65±0.34b

Data are expressed as mean ± SE.

Means with different superscript letters in the column are significantly differences at ($P < 0.05$).

Conclusion

Okra is gaining importance due to its therapeutic activities and is also known as functional food owing to its pharmacological properties mainly anti-diabetic, anti-hypercholesterolemic and anti- obesity activities. Hypercholesterolemia leads to various complications due to oxidative stress and elevated cholesterol levels in the blood. Concisely, okra (*Abelmoschus esculentus*) has been proved advantageous in reducing hypercholesterolemia. Okra pots and its head play a crucial role in the maintenance of lipid profiles in the body. Conclusively, it was concluded from the present study that okra pots and their head possess essential health benefits.

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الملخص العربي

تناولت هذه الدراسة التعرف على كيفية تأثير قرون البامية ورؤوسها على مستويات الدهون في الفئران المصابة بارتفاع نسبة الكوليسترول في الدم لمدة ثمانية أسابيع. تم تقسيم ثمانية وأربعين فأرًا ذكرًا بالغًا إلى مجموعتين رئيسيتين. تم تغذية المجموعة الرئيسية الأولى ٦ فئران على نظام غذائي عادي واستخدمت (مجموعة الضابطة السالبة). المجموعة الرئيسية الثانية المكونة من ٤٢ فأرًا، تم تغذيتها على نظام غذائي عالي الكوليسترول لإحداث ارتفاع الكوليسترول في الدم لمدة ٤٢ يومًا، ثم تم تقسيمها إلى ست مجموعات فرعية على النحو التالي: تم تغذية المجموعة الفرعية (١) على نظام غذائي عالي الكوليسترول واستخدمت كمجموعة ضابطة إيجابية. تم إعطاء المجموعات الفرعية (٢ و٣ و٤ و٥ و٦ و٧) أنظمة غذائية عالية الكوليسترول تضمنت مكملات من مسحوق ٢.٥٪ و٥٪ من رأس البامية والبامية بدون الرأس والبامية مع الرأس لكل كجم من النظام الغذائي الأساسي على التوالي. وفقًا للنتائج التي تم الحصول عليها، وجد أن إنزيمات الكبد ووظائف الكلى ومستوى الدهون قد انخفضت بشكل ملحوظ ($P \leq 0.05$) بينما زاد HDL–C بشكل ملحوظ عن طريق مجموعة التي تغذت على رأس البامية والبامية بدون الرأس والبامية مع الرأس عند المستويات المختبرة مقارنة بمجموعة التحكم الإيجابية. علاوة على ذلك، زادت بشكل ملحوظ إنزيمات مضادات الأكسدة (SOD وCAT) بينما انخفض MDA بواسطة رأس البامية والبامية ومكملات البامية مع الرأس عند المستويات المختبرة في الفئران المصابة بفرط كوليسترول الدم. في الختام، قللت قرون البامية ورؤوسها بشكل ملحوظ من مستويات الكوليسترول مع تحسين إنزيمات الكبد ووظائف الكلى وإنزيم مضاد للأكسدة. لذلك، يمكن التوصية بقرون البامية ورؤوسها لمرضى فرط كوليسترول الدم.

الكلمات المفتاحية :قرون البامية، رأس قرون البامية، ارتفاع الكولسترول في الدم، صورة دهون الدهون، مضادات الأكسدة.