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تحية طيبة وبعد،،،

يسر **معامل التأثير والاستشهادات المرجعية للمجلات العلمية العربية (ارسيف – ARCIF)**، أحد مبادرات قاعدة بيانات **"معرفة"** للإنتاج والمحتوى العلمي، إعلامكم بأنه قد **أطلق التقرير السنوي التاسع للمجلات للعام 2024**.

ويسرنا تهنئتكم وإعلامكم بأن **المجلة المصرية للدراسات المتخصصة** الصادرة عن **جامعة عين شمس، كلية التربية النوعية، القاهرة، مصر، قد نجحت في تحقيق معايير اعتماد معامل "ارسيف Arcif"** المتوافقة مع المعايير العالمية، والتي يبلغ عددها **(32) معياراً**، وللاطلاع على هذه المعايير يمكنكم الدخول إلى الرابط التالي: http://e-marefa.net/arcif/criteria/

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The Effect of Fish Oil Enriched with Omegas on Cardiovascular Diseases in Experimental Rats

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The Effect of Fish Oil Enriched with Omegas on Cardiovascular Diseases in Experimental Rats

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Abstract

The current study aims to find out the effect of fish oil with different types of omegas on male mice with heart disease, The results showed that there is a noticeable change in body weight for the groups treated with omega in the mice, and that treatment with omega increases the percentage of total change in body weight in the mice. All the results of mice with heart disease that were treated with different types of omegas proved to have an almost similar number of red blood cells. The results showed that the group treated with omega 3, followed by the group treated with a mixture of omegas, had the best results for total cholesterol. The results also showed that the groups treated with a mixture of different types of omegas were the ones who achieved the best results for all indicators of kidney function.

Keywords: Omega, Fish Oil, Heart Disease, Lipid profile , Cardio vacuolar disease , rats

ملخص:

العنوان : تأثير زيت السمك المدعم بأنواع مختلفة من الاوميجا على امراض القلب والاوعية الدموية لدي فئران التجارب

المؤلفون : أسامة السيد مصطفي ، ولاء إبراهيم انيس ، هالة راشد عطايا ، مها أشرف السيد عبد اللطيف

تهدف الدراسة الحالية الي معرفة تأثير زيت السمك مع أنواع الاوميجا المختلفة على ذكور الفئران المصابة بأمراض القلب ، اوضحت النتائج ان هناك تغيير ملحوظ في وزن الجسم بالنسبة للمجموعات المعالجة بالأوميجا لدي الفئران وان العلاج بالأوميجا يزيد من نسبة التغير الكلي في وزن الجسم لدي الفئران، اثبتت جميع نتائج الفئران المصابة بأمراض القلب التي عولجت بأنواع الاوميجا المختلفة لديها عدد كرات دم حمراء مماثل تقريبا، اثبتت النتائج ان المجموعة المعالجة بالأوميجا 3 يليها المجموعة المعالجة بمزيج من الاوميجا علي افضل النتائج بالنسبة للكوليسترول الكلي ، كما أوضحت النتائج ان المجموعات التي عولجت بمزيج من أنواع الاوميجا المختلفة هي التي حققت افضل النتائج بالنسبة لجميع مؤشرات وظائف الكلي .

الكلمات الدالة : الاوميجا، زيت السمك، امراض القلب، مستوي الدهون، امراض القلب والاوعية الدموية، الفئران.

Introduction

Heart and blood vessel diseases, also known as cardiovascular diseases, are a leading cause of death worldwide. These diseases include conditions such as coronary artery disease, heart failure, stroke, and peripheral artery disease. They are characterized by the narrowing or blockage of blood vessels, which can lead to reduced blood flow and oxygen supply to the heart and other organs **(Caldwell et al., 2018).**

The significance of studying the impact of different types of omega fish oil on heart and blood vessel diseases lies in the potential to identify the most effective and beneficial form of omega fish oil for preventing and managing these conditions. While, omega-3 fatty acids are the main components of omega fish oil, the ratio of eicosatetraenoic acid (**EPA**) to docosahexaenoic acid (**DHA**) and the presence of other bioactive compounds can vary among different types of fish oil supplements Omega-3 is a type of polyunsaturated fatty acid that is essential for the proper functioning of the human body. It is considered an essential fatty acid because our bodies cannot produce it on their own, so we must obtain it from our diet. Omega-3 fatty acids play a crucial role in maintaining overall health and well-being **(Calder, 2020).**

Polyunsaturated fatty acids (PUFAs) may regulate the antioxidant signaling pathway and modulate inflammatory processes. They also influence hepatic lipid metabolism and physiological responses of other organs, including the heart. Longitudinal prospective cohort studies demonstrate that there is an association between moderate intake of the omega-6 PUFA linoleic acid and lower risk of cardiovascular diseases (CVDs), most likely because of lower blood cholesterol concentration. studies (**Yayasan, 2022**) show that higher intakes of omega-6 PUFAs, especially eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA), are associated with a lower incidence of chronic diseases characterized by elevated inflammation, including CVDs**.**

Omega-9 fatty acids represent one of the main mono-unsaturated fatty acids (MUFA) found in plant and animal sources. MUFA represents a healthier alternative to saturated animal fats and has several health benefits, including anti-inflammatory and anti-cancer characters (**Mozaffarian, 2016).**

Accordingly, this study aimed to investigate the effect of fish oil enriched with different forms of Omegas on cardiovascular diseases in experimental rats.

Key words:

Omega, fish oil, heart disease, lipid profile, cardio vacuolar disease, rats.

Materials:

- Fish oil (about 55 g were obtained from SEDICO Pharmaceutical Company on the 6thof October City, Giza) in March 2022.

-Omega of all kinds 3, 6, 9 (about 100 capsules of each type were obtained from a pharmacy for food supplements on the 6th of October City, Giza) in March 2022.

Casein, Cellulose, Fructose, Cholesterol powder, Bile salts and choline chloride were purchases from Middle East Chemical Company in Kasur Al-Any.

-Sunflower oil and Coconut oil were obtained from the local market.

- Mixture of minerals and Vitamin mixture was obtained from a veterinary pharmacy in Giza.

- Albino male mice were purchased from the Agricultural Research institute in Giza.

All the previous material and chemical were purchased during October 2022.

Methods:

Basel Diet

The basal diet (AIN-93) was prepared according to **(Reeves et al., 1993).**

Hyperlipidemic diet:

Hyperlipidemic diet was prepared according to **Kawasaki (2009).**

Duration, time, and place of conducting the experiment:

The experiment was conducted for two months in January and February 2023 at the Agricultural Research Center in Giza.

Biological Study(Animal treatments and grouping) :

Thirty-six Male rat (Albino) weighting 160 ± 10g were used. Rats were housed in well Ventilated cages and under appropriate sanitary conditions well aerated room with alternating Light and Dark cycles of 12 h each and at room Temperature of 25 ^{o}C.

Rats were divided into two main groups as follows:

The first main group (n=6 rats) was fed on the basal diet only as a control negative group (Control - (healthy group)

The second main group (n=30 rats) was induced to hyperlipidemia for two weeks and divided into five subgroups (n=6 rats for each group)

They were fed for two weeks with a DS diet Consisting of (Modification basal diet by added cholesterol powder and Bile salts 1 and 1.5%, respectively to induce rats with hyperlipidemia).

Second main groups were divided as follows:

-Sup group1: negative control group (6 rats) were fed on dyslipidemic and steatohepatitis inducer diet (**DS**) Diet without any treatment (control positive (Control +).

- **Sup group** 2: (6 rats) were fed on DS Diet supported with 50 ml fish oil +150 ml omega 3.

- **Sup group** 3: (6 rats) were fed on DS Diet supported with 50 ml fish oil +150 ml omega 6.

- **Sup group** 4: (6 rats) were fed on DS Diet supported with 50 ml fish oil + 150ml omega 9.

- **Sup group** 5: (6 rats) were fed on DS Diet supported with 50 ml fish oil and mixture of different omega forms (50 ml omega3 +50 ml omega 6 +50ml omega 9).

Each rat was weighed at the beginning of the experiment. At the end of each week, rats have been weighed until the end of the experiment. Moreover, the weight and amount of food consumed by experiential rats for each group was recorded.

At the end of the experiment rats were fasted overnight and anesthetized with diethyl ether. At the end of each experiment, rats were fasted overnight and anesthetized. Blood samples were collected from the retro-orbital plexus from all animals of each group into clean, dry and labeled tube. The tubes contained heparin (10.01U/ml) as anticoagulant. Blood was centrifuged to separated plasma which was tightly kept in sealed aliquot tubes at -20^{o}C until biochemical assays According to **Foster and Dumns, (1973).**

Biological Evaluation:

Feed intake (FI) feed efficiency ratio (FER) and Body Weight Gain percent (BWG%) were determined according to **Bakr and Header (2014).**

BWG% and FER were calculated according to the following equation:

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

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

Biochemical analysis of serum:

The Following determinations were carried out for serum samples:

lipide profile:

Determination of lipid profile

Determination of serum Cholesterol, triglycerides, HDL and VLDL, LDL were examined by bioassay systems, as described by **Zollner (1962**), **Takahashi (2016)**

Determination of cardiovascular disease (CVD)risk factor:

It was determined according to the method of **Ivanova (2017)**.

Using the following formula:

$$\textbf{CVD risk} = \frac{\text{total cholesterol}}{\text{HDL}}$$

Calculation of the atherogenic Index (AI) risk factor:

It was calculated according to **Ivanova (2017)**.

As follow:

$$\textbf{AI (mg\dl)} = \frac{\text{LDL-c + VLDL-c}}{\text{HDL}}$$

Determination of liver function:

Determination of Alanine aminotransferase (ALT and AST):

Determination of serum alanine amino transferase (ALT and AST) were measured according to the method described by **Henry et al., (1960).**

Determination of kidney functions:

Uric acid was determind according to the colorimetric method described by **Vassault et al (1986).** Moreover**,** Creatinine

and urea nitrogen were determined according to method described by Chaney **et al (1962).**

Result and discussion:

Table (1): Effect of fish oil Enriched with different omega forms on Body weight, BWG%, FI and FER for rats suffering from cardiovascular diseases

Groups	Initial body weight(g)	Final Weight(g)	Feed Intake (g)	BWG %	FER %
Control(-Ve)	201.0^{a}±6.2	259.2^{d}±4.3	19.5^{d}±2.1	28.95^{c}	1.48^{c}
Control(+Ve)	208.3^{a}±8.4	312.0^{a}±9.4	24.3^{a}±1.9	49.78^{a}	2.04^{a}
Omega 3	210.6^{a}±5.6	268.6^{c}±7.8	20.8^{c}±0.8	27.54^{d}	1.32^{d}
Omega 6	206.8^{a}±7.7	281.4^{b}±6.2	22.8^{b}±0.4	36.07^{b}	1.58^{b}
Omega 9	203.5^{a}±5.9	278.2^{b}±8.2	22.3^{b}±0.9	36.70^{b}	1.64^{b}
Omega 3.6.9	209.1^{a}±9.6	265.2^{c}±5.3	20.7^{c}±1.2	26.82^{d}	1.29^{d}

BWG% means Body weight percentage. FER means Fed affiance percentage.

- Values denoted arithmetic means ± standard deviation of the mean.
- Colum with different letter means that there were statistically significant different at ($P<0.05$).

Bodyweight, BWG%, FI and FER results were present in table (1). The current results indicated that there were no statistical differences between all investigated groups in initial body weight, being approximately the same. It may be due to the researcher adopting all group weight. The control positive group tended to have the highest final body weight among all tested groups. Even statistically significant differences were observed between them. All treated groups have Body Weight lower than control positive group and higher than control negative group. On the other hand, the groups treated with omega 3 and with mixture of omega 3, 6, 9 have the best results for Body Weight among all treated groups. It should be noted that the body weight for those two groups was still higher than the control negative group. Even statistical differences were observed between them. The results of BWG% and FER% showed that the control positive group was better than the control negative group. It was also found that there were statistical differences between some treated groups for BWG% and FER%. The group suffering from CVD and treated

with omega-3 had the nearest final body weight, BWG% and FER% among all treated group. This result was in general within with other study that confirmed that, the results of the current study showed that the treatment with omega-3 increases the percentage of the total body weight change in rats. **(Teng et al., 2020)** demonstrated that specific dose of fish oil mitigates DOX-induced cardiac malfunctions. The platelets number was significantly increased in the DO intoxicated rats. Treating DOX-injected rats with omega-3 led to a significant decrease in the total count of platelets.

Table (2): Effect of fish oil enriched with different omega forms on CBC (Hb – RBcS – WBcS) on rats suffering from cardiovascular diseases

Parameter / Groups	Hb (g)	RBcS×103 (cmm)	WBcS×103 (cmm)
Control (-Ve)	13.6a±0.7	4.1a ± 0.2	9.3a ±0. 6
Control (+Ve)	10.7c±0.3	3.1c ± 0.1	7.1b ± 1.4
Omega 3	12.8b±0.4	3.9b ± 0.2	6.7c ± 1.1
Omega 6	12.3b±0.9	3.7b ± 0.2	5.9c ± 0.7
Omega 9	12.1b±0.6	3.5b ± 0.3	6.0c ± 1.6
Omega 3.6.9	12.7b±0.6	3.8b ± 0.4	6.4c ± 1.2

Hb: Hemoglobin. RBcs: Red Blood Cell. WBcS: White Blood Cell.

- Values denoted arithmetic means ± standard deviation of the mean.
- Colum with different letter means that there were statistically significant different at ($P<0.05$).

The CBC data for rats suffering from CVD and treated with fish oil enriched with different omega forms (3, 6 and 9) were illustrated in table (2). The results for Hb showed that the control negative group was better than the control positive group. There were statically significant differences at ($P<0.05$) that have been detected between them. All CVD groups had close results for Hb. Accordingly, no significant were detected. After being treated with fish oil enriched with different omega forms or mixture of them the Hb does not reach to control negative group.

RBC and WBcS count for control negative group was higher than control positive. After being treated, RBC was higher

than control positive group but lower than control negative group. It should be noted that all CVD rats treated with different omega forms have approximately similar RBC count, so no significant were detected at (P<0.05). Accordingly, all forms of omega and their mixture had the same effect on blood picture.

The results of the current study showed that the total count of WBCs and the differential counts were significantly increased in the group of rats that injected with DOX when compared to the control groups. Omega-3 treated group showed significant decrease at (P<0.05).in the total count of WBCs and their differential counts. Previous studies showed the ameliorative effect of fish oil on the DOX induced toxicities **(Barakat et al., 2018); (Ahmed et al., 2021).**

Table (3): The effect of fish oil enriched with different omega forms on lipid profile (TC - TG – HDL – LDL – VLDL (mg/dl) and LDL\HDL) for rats suffering from cardiovascular diseases

Parameters / Groups	TC (mg/dI)	TG (mg/dI)	HDL-c (mg/dI)	LDL-c (mg/dI)	VLDL-c (mg/dI)	LDL-C / HDL (mg/dI)
Control (-Ve)	126.3e±5.2	102.6e±2.3	53.1a±4.3	51.8e±5.6	20.5e±1.0	0.97d±1.30
Control (+Ve)	171.8a±7.1	153.8a± 4.6	32.6e±1.7	103.9a±8.3	34.3a±1.4	3.18a ±4.88
Omega 3	136.8cd±6.4	111.8cd±2.4	36.2d±2.2	69.7d±4.8	27.3cd±1.2	1.92b±2.18
Omega 6	153.1b±5.8	136.5b±3.6	45.1b±3.8	94.7b±7.3	30.6b±1.1	2.09b±1.92
Omega 9	145.6c±6.7	127.3c±3.2	40.3c±3.2	74.9c±6.7	29.1c±1.3	1.85c±2.09
Omega 3.6.9	131.6d±5.6	109.6d±2.6	35.1d±1.6	66.6d±4.1	26.3d±1.1	1.89c±2.56

- Values denoted arithmetic means ± standard deviation of the mean.
- Colum with different letter means that there were statistically significant different at (P<0.05).

The data of the effect of fish oil enriched with different omega forms on lipid profile were present in table (3). The current results indicated that the control positive group tended to have the highest total cholesterol and triglyceride and VLDL among all tested groups. Even, statistically significant differences at (P<0.05). were observed between them. All treated groups had total cholesterol lower than control positive group but still higher than control negative group. On the other hand, the groups treated with omega 3 and with mixture of different omega forms (3, 6

and 9) had the best results for total cholesterol. It should be noted that the total cholesterol for those two groups was still higher than the control negative group. Even statistically significant at ($P<0.05$) differences were observed between them. From the data illustrated in table (3), appeared that groups suffering from CVD and treated with omega 3 and groups treated with different omega forms (3, 6 and 9) had total cholesterol approximately the same. Similar result was detected for TG. This result was approximately like reported in other study which confirmed that, studies have shown that EPA can help to lower triglyceride levels in the blood, which is important for reducing the risk of heart disease **(Chen, 2022).**

The previous result is in the line with Yayasan, 2022, who demonstrate that study that appears Omega-3 fatty acids have been shown to have a positive impact on cholesterol levels. They can help increase levels of high-density lipoprotein (HDL) cholesterol, also known as "good" cholesterol, while reducing levels of low-density lipoprotein (LDL) cholesterol, or "bad" cholesterol. This balance can help maintain healthy cholesterol levels and reduce the risk of atherosclerosis Accordingly, it can be said that omega 3 has the most potential effect for lowering cholesterol and TG among other forms of omega.

Data in table (3) illustrated that HDL-c was much lower for control positive group (suffering from CVD), as compared with control negative group (health group). All treated groups tended to have HDL-c higher than control positive group, but still lower than control negative group. The best group of treatment group is the group treated with omega 6, followed by groups treated with omega 3 and group treaded with mixture of omega forms.

The results regarding LDL showed that the control positive group was better than the control negative group. As for the treated groups, it was noted that there were statistically significant differences at ($P<0.05$) between them. but from the data illustrated in table (3), appeared that groups suffering from CVD and treated with omega 3 and groups treated with different omega

forms (3, 6 and 9) had LDL-c approximately the same. There were no statistically significant differences at (P<0.05) between them. It should be noted that groups treated with omega 6 had LDL-c one-third more than groups treated with omega 3 or groups treated with mixture forms of omega. It means that omega 3 had the strongest effect for reducing LDL-c, as compared with other omega forms.

The results for LDL\HDL were proven that. The control positive group was approximately three times higher than the control negative group. There were no statistically significant differences between treated groups with omega 3 and omega 6. Moreover, there were no statistically significant differences between treated groups with omega 9 and mixture of omega forms (3, 6 and 9).

From the above-mentioned data, it could be clear that, Fish oil supported with different forms of omega have TG, TC lower than untreated group. This result was completely agreed with the other which reported that omega have also been found to improve lipid profiles by lowering triglyceride levels and increasing high-density lipoprotein (HDL) cholesterol levels **(Gioxari, 2018).**

The current result was completely agreed with other which reported that, Omega fish oil has been shown to have a beneficial effect on triglyceride levels omega-3 fatty acids have been found to reduce triglyceride levels by decreasing the production of triglycerides in the liver and increasing their clearance from the bloodstream. They also improve insulin sensitivity, which can help lower triglyceride levels in individuals with insulin resistance **(Yayasan, 2022).**

In the present study, a significant increase in at (P<0.05) serum total lipids, cholesterol, triglycerides, and LDL-c and a significant decrease at (P<0.05). HDL-c of the rats treated with lead acetate were estimated. HDL-c helps to scavenge cholesterol from extrahepatic tissues and the decrease of HDL-c concentration as in this study contributed to increasing cholesterol

levels. There is evidence linking increased serum cholesterol and LDL-c levels to a higher risk for developing coronary heart diseases. with other research which indicated that, Studies (**Yayasan, 2022**) have shown that omega-3 fatty acids can help reduce the risk of heart disease. They have been found to lower triglyceride levels, reduce blood pressure, and prevent the formation of blood clots. These effects can significantly reduce the risk of heart attacks and strokes.

The present results exhibited that there was a significant decrease at ($P<0.05$) in serum total lipids, cholesterol, triglycerides, and LDL-c and a significant increase at ($P<0.05$) of HDL-c of the rats treated animals with Omega-3 in groups 2 and 3 compared to lead acetate treated group. **DeSagana et al., (2014)** suggested that oxidative modification of low-density lipoproteins (LDL-c) caused by reactive oxygen species results in the formation of foam cells which is the initial lesion of atherosclerosis. They also reported that LDL-c oxidation and atherogenesis can be inhibited by nutritional antioxidants. There is also epidemiological evidence and interventional studies to correlate higher levels of antioxidant-rich food uptake with lower incidence of coronary heart disease.

This result was within with other research which indicated that studies have shown that supplementation with omega fish oil can lead to a favorable change in the ratio of LDL cholesterol to HDL cholesterol, which is an important indicator of heart health**.** In addition to reducing LDL cholesterol levels and increasing HDL cholesterol levels, omega fish oil has been found to improve the size and density of LDL particles. Smaller, denser LDL particles are more likely to contribute to the development of atherosclerosis, while larger, less dense particles are less harmful. Omega-3 fatty acids have been shown to increase the proportion of larger LDL particles, which may help reduce the risk of heart disease (**Caldwell KL et al., 2018).**

The previous result is in line with **(Caldwell KL et al., 2018).** study that appears Omega-6 fatty acids, particularly

linoleic acid, have been associated with cardiovascular health benefits. They help lower LDL (bad) cholesterol levels and reduce the risk of heart disease. Omega-6 fatty acids also play a role in maintaining healthy blood pressure levels and reducing inflammation in the blood vessels, which can contribute to improved cardiovascular health.

Table (4): The effect of fish oil Enriched with different omega forms on kidney's function for rats suffering from cardiovascular diseases (mg/dl)

Parameters / Groups	Urea (mg/dI)	Creatinine (mg/dI)	Uric acid (mg/dI)
Control (-Ve)	28.8d± 2.2	0.77d±0.12	2.52d±0.26
Control (+Ve)	46.7a± 4.4	1.64a±0.21	5.61a±0.47
omega 3	30.2c± 2.7	0.98 c±0.13	2.92b±0.60
omega 6	39.1b± 3.1	1.35b±0.09	4.38b±0.56
Omega 9	34.8b± 1.7	1.32b±0.16	4.13b±0.50
omega 3.6.9	29.8c± 2.8	0.91c±0.18	2.80c±0.31

- Values denoted arithmetic means ± standard deviation of the mean.
- Colum with different letter means that there were statistically significant different at ($P<0.05$).

The results of the effect of fish oil enriched with different omega forms on kidney functions were illustrated in table (4). The current findings were regarding urea, creatinine and uric acid in the control positive group being higher than the control negative group. It was even noted that there was a statically difference between them. It was clear that all treated groups were going to be lower than control positive group for all tested kidney function parameters. Groups that were treated with mixture of omega forms (3,6 and9) tended to have the best results for all examined kidney function parameters. In despite of, rats suffering from CVD and treated with mixture of omega forms had the best results for kidney functions but still not achieve for healthy group. The data present in table (4) illustrated that groups treated with omega 3 had urea nitrogen and creatinine much lower than control positive group and close to reported for groups treated with mixture of omega.

All groups fed on diet enriched with fish oil plus different omega forms had better kidney function, as compared with control positive group. It may be due to fish-oil reduced cytokine content and macrophage counts in kidney tissue following short-term (i.e., 4 days), are consistent with data from in vitro studies **(Mistreat al., 2014); (Moreover Diaz Encarnacion et al., 2018)** reported that fish oil reduces macrophage infiltration and fibrosis in kidney tissue from salt-sensitive rats with hypertension. In addition, smaller doses of fish oil are also effective for reducing inflammation and fibrosis in the kidney following ureteral obstruction (REF).

The current result completely agrees with other studies which reported that, fish oil is known for its anti-inflammatory properties and has been shown to have a positive impact on heart health. EPA helps to reduce the production of inflammatory substances in the body, such as prostaglandins and leukotrienes, which can contribute to the development of heart disease **(Gioxari, 2018).**

Table (5): The effect of fish oil enriched with different omega forms on lipid profile (AI- CVD) for rats suffering from cardiovascular diseases

Parameters / Groups	AI (mg/dI)	CVD (mg/dI)
Control(-Ve)	1.36 c ±1.53	2.37 c ±1.20
Control(+Ve)	4.23 a ±5.70	5.26 a ±4.27
Omega 3	2.67 b ±2.72	3.77 b ±2.90
Omega 6	2.77 b ±2.21	3.39 b ±1.52
Omega 9	2.56 b ±2.5	3.61 b ±2.09
Omega 3.6.9	2.64 b ±3.25	3.74 b ±3.5

AI: Atherogenic Index CVD: Risk Factor

- Values denoted arithmetic means ± standard deviation of the mean.
- Colum with different letter means that there were statistically significant different at ($P<0.05$).

The AI and CVD count for control Positive group was higher than control Negative. As for the treated group whether in AI and CVD, there are no statistically significant differences between them compared to the control groups. The current result

was completely agreed with other study which reported that, Longitudinal prospective cohort studies demonstrate that there is an association between moderate intake of the omega-6 PUFA linoleic acid and lower risk of cardiovascular diseases (CVDs), most likely because of lower blood cholesterol concentration. **(Yayasan, 2022).**

Cardiovascular diseases (CVD) and their complexity, intimately linked to diet, are substantial public health issues. Hepatic enzymes are liver function parameters, also referred to as hepatic objects, and are groups of blood tests that provide information about the state of a patient's liver. To investigate the potential effects of a plant-based high-fiber enrichment diet on improving hepatic enzymes in growing rat models to prevent and manage CVD. The current investigation developed a fiber-enriched diet and compared it with control, high-fat, and other formulated diets on rat models **(Ortega, 2019).**

The current result completely agreed with other study which reported that, High blood pressure is a major risk factor for heart disease and stroke. Omega-3 fatty acids have been found to help regulate blood pressure levels, particularly in individuals with hypertension. They can help lower both systolic and diastolic blood pressure, leading to improved cardiovascular health **(Mori, 2018).**

this result was within with another research **(Bhatt et al., 2019)** which indicated that, by reducing the levels of these inflammatory molecules, omega fish oil can help alleviate inflammation in the blood vessels and prevent the damage associated with chronic inflammation**.**

The previous result is in line with (**Harris et al., 2021).** study that appears It is rich in omega-3 fatty acids, which are essential nutrients that play a crucial role in maintaining heart and blood vessel health.

The current result completely agreed with other study which reported that, Numerous scientific studies have shown that

omega-3 fatty acids can have a positive impact on various aspects of cardiovascular health, including reducing the risk of heart disease **(Aglago et al.,2020).**

This result was within which indicated that fish oil is known for its anti-inflammatory properties and has been shown to have a positive impact on heart health. EPA helps to reduce the production of inflammatory substances in the body, such as prostaglandins and leukotrienes, which can contribute to the development of heart disease **(Gioxari, 2018).**

Conclusion:

In concision using sources rich on different forms of omegas improve general health, specially, lipid profile, liver and kidney functions. It should be noted that, all omega forms specially, omega 3 had most powerful effect on health. Accordingly, it recommended to use daily food rich in different omega forms such as oily fish and flax seeds oil.

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