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Study of the Relationship between Lycopene and Antioxidants in Obese Patients

Antesar Rheem Obead[1*], Zahraa Kadhim Abbas[2]

[1]*Department of Pharmaceutical Sciences, Babylon University, Hilla, Iraq*
[2]*Department of Chemistry, University of Kufa, Hilla, Iraq*

[*]***Corresponding author:*** *Antesar Rheem Obead, Department of Pharmaceutical Sciences, Babylon University, Hilla, Iraq; E-mail: Antesar.m2016@gmail.com*

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ABSTRACT

Lycopene is a plant pigment that is characterized by its bright red color. It is found in red tomatoes and many fruits and vegetables such as watermelon, papaya and red carrots. It is not an essential nutrient for humans, but it is found accumulated in the liver, adrenal glands and testicles. The research aims to study the effect of both weight loss and some natural antioxidants such as lycopene, whole grains and vitamin C on liver performance in women with obesity and fatty liver. Knowing the extent of the risk caused by fatty liver disease in increasing oxidative stress in women and thus increasing the risk of complications caused by the disease. Identifying some preventive foods that protect against fatty liver disease and thus protecting against complications caused by the disease. Determining the role of antioxidants, the subject of the research, as one of the means of preventing complications of fatty liver disease and thus determining ways to prevent the disease.

Keywords: Lycopene; Obesity; Liver enzyme; Triglyceride; Cholesterol

INTRODUCTION

Obesity is considered one of the biggest health problems facing the world today, as it results in the risk of many chronic diseases, including heart disease, diabetes and high blood pressure. Recent studies have shown that it is one of the most important causes of non-alcoholic fatty liver disease. Studies have shown the seriousness of non-alcoholic fatty liver disease, which can develop into cirrhosis and then liver cancer.

Sangal, showed that the causes of non-alcoholic fatty liver disease are usually associated with obesity and overweight and that fatty liver disease can lead to more serious complications for the liver, as the scope of infection begins with Fatty Liver (FL), then steatohepatitis, which leads to hepato fibrosis, then develops into hepato cirrhosis and infection may reach the point of hepatocellular carcinoma. Thus, cases of fatty liver disease generally represent a huge burden on health care in any region of the world. The study conducted by Cheung and Sanya showed that there is no drug treatment for non-alcoholic fatty liver disease and that the treatment lies in reducing weight and increasing physical effort to improve the condition of the liver and tissues and increasing the metabolic rate to burn the fat accumulated in the liver. The study also focused on the fact that prevention of risk factors is the best way to avoid fatty liver disease [1].

In a study on the rate of consumption of vegetables and fruits high in antioxidants, especially vitamin C and the possibility of reducing the rate of production of insulin-like growth factor or gene, which is associated with many chronic diseases such as many types of cancer, cardiovascular diseases and lowering blood and liver fat levels, this factor was measured for 37 adult women aged (35-45 years) before they consumed meals high in citrus fruits for 6 weeks, with both triglycerides and total cholesterol measured. Then this factor was measured after the diet period and it was found that there was a significant statistical decrease ($P<0.05$), as well as a decrease in the percentage of both cholesterol and triglycerides. This study concluded that women who follow a diet high in citrus fruits and high in vitamin C have a lower rate of insulin-like growth factor and thus a lower rate of chronic diseases.

In a study conducted by Frusciante, et al. he linked daily consumption of tomatoes to a reduced risk of metabolic inefficiency which leads to many diseases including fatty liver, diabetes and cancer. The study also showed the presence of many important substances in tomatoes which improve human health including lycopene.

In a study showing the effect of some whole grains on patients with heart and arterial diseases by knowing the percentage of insulin they need as well as the percentage of fat oxidation they have. The study was conducted on 76 Korean males with heart and arterial diseases. The sample was divided into groups in addition to the control sample. White rice was replaced from their meals with whole grains for 16 weeks. In the test

group (whole grains), the concentration of both insulin and glucose decreased by 14% and 24% respectively without changing the total energy intake or weight, while both fiber and vitamin E increased by 25% and 41% respectively.

In the group of patients with cardiovascular disease who did not have diabetes and increased their consumption of whole grains, there was a decrease in blood sugar and insulin levels. The levels of both homocysteine and malondialdehyde decreased by about 28%. It was also found in the same group that phytochemicals led to a modification in the concentration of both alpha-carotene, tocopherol, retinol and lycopene ranging from 11% to 40%. It was also found that the percentage of fatty acids with six-bond n-6 in the serum increased by 14%. It was found that replacing white rice with whole grains as a source of carbohydrates created a significant relationship with the levels of glucose, insulin, homocysteine and lipid oxidation in people with cardiovascular disease. This briefly explains the reduction in the risk of cardiovascular disease and diabetes [2].

Due to the continuous increase in the discovery of fatty liver cases that are accompanied by obesity, diabetes or high blood lipids or that are associated with malnutrition represented by the phenomenon of starvation or rapid weight loss without careful observation by a nutritionist or weight loss cases by gastric banding and due to the serious complications caused by the formation of fatty liver on the performance of the liver functions, which may lead to cirrhosis in its tissues and may reach the state of liver cancer. Therefore, this research was prepared to study the effect of weight loss with the use of antioxidants such as fat-soluble lycopene, water-soluble vitamin C and whole grains containing fiber and phytochemicals on liver performance in women suffering from obesity and non-alcoholic fatty liver.

Lycopene is a fat-soluble plant pigment that gives the red color to fruits and vegetables. It is a type of carotenoid and is found in watermelon, tomatoes, grapefruit, red guava, papaya and apricots. Its absorption in the body is quadrupled when it is cooked moderately, due to the release of lycopene molecules from the cells during cooking. Since it is a fat-soluble pigment, it is preferable to consume it in a small amount of good fats such as olive oil [3].

Lycopene content in food

Tomatoes are the main source of lycopene, followed by hibiscus, watermelon, papaya, red guava, red grapefruit and apricots. Tomatoes are an excellent source to rely on daily as a source of lycopene, as tomatoes are included in many daily meals. The lowest amount of lycopene is found in raw tomatoes and the highest in processed tomatoes such as tomato paste or tomato sauce. All of the manufacturing, storage or freezing processes do not affect the total lycopene content.

The role of lycopene as antioxidant

Lycopene is a type of carotenoid and recent studies have proven its essential role as an antioxidant. Recent studies have shown the ability of antioxidants to deactivate active oxygen atoms and provide protection from oxidative damage to cells, as it works to protect against cardiovascular diseases and cancer. These studies recommend increasing the intake of plant foods, which include vegetables, fruits, grains and legumes. Epidemiological studies show a strong relationship between eating high calories, a diet high in fat or meat or eating a diet low in fiber, which increases the risk of developing various types of cancer. In a study on the effect of lycopene, the subject of the research, as an antioxidant on liver function and blood lipid analysis, a group of researchers at Helwan University in Egypt conducted a study on the effect of tomato powder prepared from fresh tomatoes on a group of albino mice. The mice were divided into two main groups: The first was the control sample with regular meals, while the second group was divided into seven subgroups with varying amounts of lycopene (10 to 20 mg of lycopene/kg of food). Liver enzymes, total cholesterol and triglyceride levels in the blood were measured. The results showed an improvement in these rates as the percentage of lycopene added to the mice's meals increased. This study recommended conducting awareness programs on the importance of tomato products, especially tomato sauce and juice, in protecting against high blood lipids [4].

MATERIALS AND METHODS

This study was conducted on a sample of women in Babylon city during the period from December to August 2024. The total sample consisted of 200 Saudi and non-Saudi women with obesity (BMI $\geq$ 30) aged between 35-55 years to determine the prevalence of fatty liver among them and their awareness of antioxidants and fatty liver. Then, a sub-sample of 30 women with fatty liver was selected to determine the effect of antioxidants and weight loss on them in improving the condition and functions of the liver.

Laboratory analysis of the total sample

All laboratory analysis of the total research sample (200 women) was done in the laboratories of each hospital for review, with all analyses attached to the file of each patient. The samples were drawn in the analysis laboratory by a specialized laboratory technician who drew a blood sample from each patient's vein. The plasma was separated from the blood samples by centrifugation at a speed of 3000 rpm for 15 minutes and the analysis was done by a dimension ® clinical chemistry system from Siemens using flex ® reagent cartridge.

RESULTS AND DISCUSSION

This chapter contains the results of the questionnaire and laboratory tests, which include three main parts: Personal and demographic data, health status and weight loss methods for the total sample. The second part deals with: the relationship between obesity and other factors and fatty liver disease, the third part: the relationship between the consumption of antioxidants, the subject of the research and the weight loss system on both blood tests and liver status for the sub-sample [5].

Frequency distribution of laboratory and ultrasound analysis results for the total sample

Table 1 shows the frequency distribution of blood lipid analysis results. By analyzing the total sample, it was found that 55 women had high blood triglycerides, at a rate of 27.5%. As for women who had normal triglycerides, their percentage was 72.5% for 145 women. When asked, it was found that only 32 women were aware of the infection. As for high cholesterol, it was found that 42 women, at a rate of 21%, had high blood cholesterol and all of them had high triglycerides. While it was found that 158 women, at a rate of 79%, had normal cholesterol.

Table 1: Frequency distribution of blood lipid analysis results.

Analysis results	Number	Percentage %
Blood test results for triglycerides		
Normal	145	72.5
High	55	27.5
Cholesterol test results		
Normal	158	79
High	42*	21
Note: *All women with high cholesterol have high triglycerides.		

The liver enzyme analysis data in Table 2 showed that only 93 women of the total sample, representing 46.5%, had a normal aspartate aminotransferase level, compared to 107 women, representing 53.5%, who had an elevated aspartate aminotransferase level, compared to an elevated alanine aminotransferase level for 99 women, representing 49.5%. As for the normal alanine aminotransferase level, it was found that 101 women, representing 50.5%, had a normal alanine aminotransferase level [6-8].

Table 2: Frequency distribution of liver enzyme analysis results.

Analysis results	Number	Percentage %
Blood test results for AST		
Normal	93	46.5
High	107	53.5
ALT test results		
Normal	99	49
High	101	50.5

The relationship between obesity and various factors and the incidence of fatty liver

The relationship of demographic data to the incidence of obesity degrees for the total sample: The older the age, the higher the incidence of obesity. It was found that the incidence of third-degree obesity is most prevalent among the age group (46-50) years at a rate of 10%, while it is prevalent at a rate of 0.5% among the age group (41-45) and 1% for the age group (35-40).

From the above, it is clear that there is a highly significant statistical relationship between age and the incidence of obesity with a confidence level of 99%, at the significance level (0.000) and by calculating the coefficient of agreement, it was found to be equal to (0.533), which means that the increase in the incidence of obesity depends on age by 53.3% [9].

This is consistent with the study of Shan, et al., who noted an increase in the degree of morbid obesity (third-degree obesity) among the research sample who were over 50 years old. The study clarified the effect of both age and obesity on increased fat deposition in the liver and the incidence of non-alcoholic fatty liver disease as well as on metabolic disorders such as insulin resistance in cells. The study showed the effect of both nutrition and increased physical effort for six months on improving body functions and reducing fat deposition in the liver. A significant relationship with a very high statistical significance was found, less than the significance level (0.05) between each of following a diet free of fats and sugars and increasing physical effort with an improvement in the percentage of both triglycerides and cholesterol and increased insulin sensitivity [10].

Table 3: Relationship between age and obesity severity.

	First class		Second class		Third class		Total		Significance
Age	No	%	No	%	No	%	No	%	
35-40	15	7	49	24.5	2	1	66	33	P=0.00 Coefficient of agreement=0.533 Confidence level=99%
41-45	40	20	29	12.5	1	1.5	70	35	
46-50	-	-	44	22	0	10	64	32	

The results in the Table 3 also show the relationship between the educational level and the high degree of obesity among the total research sample, as the rate of third-degree obesity increases by 5% among women who have low education, while 1% of them have intermediate education and there are no women with third-degree obesity among women who have high education. Therefore, the relationship is highly significant with statistical significance between the level of education and the degree of obesity with a confidence level of 99% at the significance level (0.000).

By calculating the coefficient of agreement, it was found to be equal to 0.604, which means that the degree of obesity is related to the educational level by 60.4%. This is a similar result to the study conducted in rural Spain on women and the study of the relationship between obesity and educational level related to lifestyle on 1298 women of different age groups. It was found that obesity is more prevalent among women with a low educational level (primary or less) and low education is associated with poverty and lack of health awareness [11].

The relationship between different factors and the incidence of fatty liver

Table 4 shows the relationship between obesity and fatty liver, as statistical analyses showed that 17.2% of those infected with fatty liver were infected with the third degree of obesity, while 74.6% of them were infected with the second degree, while no more than 8.2% of them were infected with the first degree. Therefore, it is clear from the above that there is a highly significant statistical relationship between fatty liver and obesity with a confidence level of 99% at the significance level (0.000) and when calculating the coefficient of agreement, it was found to be equal to (0.531), which means that exposure to fatty liver increases with the increase in the degree of obesity by 53.1%. This is consistent with a study conducted in Huilin City, Taiwan, where the study was conducted on 220 students aged 12 and 13 years of normal weight, overweight and obese. After undergoing examinations and ultrasound, it was found that 86 students (39.8%) had non-alcoholic fatty liver disease, 16% of them had normal weight, 50.5% of them were overweight and the largest percentage was among those with obesity. The study recommended that adolescents with obesity undergo regular liver examinations.

Table 4: The relationship between fatty liver disease and the degree of obesity.

Degrees of obesity	Fatty liver		Non fatty liver		Total		Significance
	No	%	No	%	No	%	
First stage	11	8.2	44	66.7	55	27.5	P=0.000 Coefficient of agreement=0.531 Confidence level=99%
Second stage	100	74.4	22	33.3	123	61	
Third stage	23	12.2	-	-	22	11.5	

Average difference of oxidative potential (glutathione peroxidase enzyme and total antioxidants) of the sample

Table 5 shows the average measurement of the glutathione peroxidase enzyme, which is considered an indicator of the degree of oxidation. A difference was found in the differences between the enzyme measurement before and after the diet for the three groups with significant differences with a very high statistical significance with a confidence level of 99% at a confidence level of (0.000). Therefore, we reject the null hypothesis and there are significant differences with a statistical significance for the average difference between the enzyme measurement before and after the diet for the three groups. The average glutathione peroxidase enzyme level was calculated for the sub-sample before and after the diet in the three groups. Before the diet, the average in the first group (vitamin C group) was 12.4 units/liter and decreased to 9.6 units/liter. In the second group (lycopene group), the average enzyme level was 14.1 units/liter and decreased to 11.3 units/liter after the diet. The average of the third group (whole grain group) was 18.6 units/liter before the diet and decreased to 11.3 units/liter after the diet. The average decrease for both the first and second groups was 2.8 units/liter, while the decrease in the third group was 7.3 units/liter [12].

Table 5. Mean difference of glutathione peroxidase enzyme measurement for the group.

Type of antioxidants	Average glutathione peroxidase enzyme before the experiment Unit/L	Average glutathione peroxidase enzyme After the experiment Unit/L	Average drop Unit/L	Significance
Group (1) Vitamin C	12.4	9.6	2.8	T=10.23 P=0.000 99% confidence level
Group (2) Lycopne	14.1	11.3	2.8	
Group (3) Whole grains	18.6	11.3	7.3	

Table 6 shows the average measurement of total antioxidants, which indicates the oxidative stress in human cells. The average measurement of antioxidants in the first group (vitamin C group) before the diet was 20.75 mmol/L, while after the diet it rose to 40.33 mmol/L. As for the second group (lycopene group), the average of total antioxidants before the diet was 18.04 mmol/L, while after the diet it rose to 38.55 mmol/L, while the average of the third group (whole grain group) before the diet was 25.22 mmol/L, while after the diet it rose to 50.88 mmol/L. There were highly significant statistical differences with a confidence level of 99% at a significance level of (0.000), so we reject the null hypothesis. There are significant differences between the average measurement of total antioxidants before and after the diet. In the first group, it was 19.58 mmol/L and in the second group, it was 20.51 mmol/L. As for the third group, the difference was higher and reached 25.66 mmol/L.

Table 6: Mean difference for measuring total antioxidants of the sample.

Type of antioxidants	Average total antioxidants before experiment mmol/L	Average antioxidants After experiment mmol/L	Average height mmol/L	Significance
Group (1) Vitamin C	20	40	19	T=10.23 P=0.000 99% confidence level
Group (2) Lycopne	15	38	20	
Group (3) Whole grains	27	55	25	

CONCLUSION

Machado, et al., explained in his study on the necessity of diet in patients with fatty liver by comparing 43 people with fatty liver and 33 healthy people in the control sample, a nutritional survey was conducted and the intake of fats, carbohydrates, fibers, vitamins C and E was evaluated. Analyses were conducted for each of the enzyme glutathione peroxidase, total antioxidants, vitamin A and vitamin E and the amount of total antioxidants and vitamin E was found to be higher in patients with fatty liver, vitamin A was higher in healthy people and there was no difference in the enzyme glutathione peroxidase between the two groups. However, there was a difference and improvement in the previous percentages in those who followed a diet to reduce weight among patients with fatty liver.

APPROVAL OF THE MEDICAL ETHICS COMMITTEE

The experimental method was approved in this research by presenting it to the Ethics Committee of Al-Hillah Teaching Hospital, where the practical experimental part is conducted on patients visiting the hospital and written consent was obtained from the patients.

Lycopene: 11 types of food were selected, only 4 of which contain lycopene, which are (watermelon, tomatoes, sauce and beets) and the remaining seven do not contain lycopene, which are (apples, zucchini, radishes, watercress, brown bread, eggs and green peppers).

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