



Palm Olein Oil Effect on the Heart Tissue of Male Rats

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Abstract

Background: Palm olein oil is one of the most widely used oils, so the available reports show that its consumption has different health effects, some of them are beneficial and some are harmful.

Objectives: This study aimed to investigate the effect of heated and unheated date olein in different doses on the hearts of male rats.

Methods: In this study, 40 male rats were divided into 5 groups: Sham group with a regular diet, palm oil group with 10% (W/W) palm oil diet, palm oil group with 20% (W/W) palm oil diet, ghee oil group 7.5% (W/W) and heated palm oil group with 20% (W/W) palm oil diet. Palm olein oil was added to rat foods in experimental groups for 60 days. 24 hours later, the rats were dissected, then the heart tissue of the rats was sampled and tissue sections were prepared and analyzed with an optical microscope.

Results: The results of this study indicated that fresh unheated palm oil does not have any harmful effects on the heart tissue, but the consumption of heated palm oil causes to damage the heart tissue.

Conclusions: The results showed the negative effects are correlated to the dose and the heating. The heart tissues which treated with higher doses and heated palm olein oil had more side effects.

Keywords: Heated Palm, Cardiac, Necrosis, Histology, Antioxidant, Ghee Oil

1. Background

Palm oil is produced from the fruit of the *Elaeis guineensis* tree and has been used for food for some 5,000 years. In the 19th century, palm oil entered the world trade, and in 1988, Malaysia produced 4.5 tons of crude palm oil, accounting for 58% of global production. Palm oil can be divided into palm olein and palm stearin (1). The tocotrienol-rich fraction (TRF) of red palm oil is also cardioprotective and recently various tocotrienol isomers have been shown to act as a potent neuroprotective agent against stroke (2). Heat processing of palm oil which is a common method, can cause oxidative damage to the oil and significantly reduce its carotenoid content, thus reducing the nutritional value and also reducing the health benefits of palm oil (3). Palm oil also consists of vitamins A and E which are strong antioxidants and also protect against plaques A and E from the heart, and blood vessels and protects against ischemic damage. Palm oil, which is consumed as a type of fat in a healthy balanced diet, does not increase the risk of cardiovascular

diseases, and without heating it strengthens and protects the heart (4). Since this oil is not consumed in its raw form, it is used in oxidized and photo-oxidized forms. This action may be toxic and mutagenic for tissues because the oxidation of lipids after using heat has harmful effects on most oils (5). Recent studies show that feeding rats with heated palm oil causes cardiovascular problems and various changes in heart tissue including the infiltration of mononuclear cells, thickening of the subendothelial layer, disruption of the internal elastic layer, and fragmentation of smooth muscle cells in the aortic tunica environment, it is also a predisposing factor for arteriosclerosis which itself leads to cardiovascular diseases (6). Consumption of palm oil with heat oxidation also leads to cytotoxicity and changes in potassium ion channel function. Heat-oxidized palm oil increased mean arterial pressure in rats and changed the tissue structure of the heart. Also, heated palm increased tissue levels of peroxide, total cholesterol, triglycerides, and low-density lipoprotein cholesterol (7). Fresh and unheated palm oil does not cause any harmful effects on blood pressure

and heart tissue, but repeatedly heated palm oil leads to increased blood pressure and causes necrosis in heart tissue (8). In addition to the effects of palm oil on rat heart tissue, the effects of free radical toxicity caused by chronic consumption of thermo-oxidized or heated palm oil diet, significantly reduced lung and kidney mass, as well as the heart size of desert rat offspring in the next generations which these findings indicate the genetic mutation of heated palm oil (9). Ghee oil contains a large amount of vitamin A, vitamin E, vitamin D, and vitamin K and helps to strengthen the immune system. Lipids of ghee oil origin contain linoleic acid and oleic acid which prevent arteriosclerosis (hardening of the arteries) create anti-inflammatory properties and also are beneficial for heart health. Animal oil also contains another fatty acid called butyrate which plays a vital role in the health of food and ghee oil if consumed in sufficient quantity will be beneficial for the heart (10). Olein palm oil is one of the most widely used oils, so its consumption has various health effects some are beneficial and some are harmful.

2. Methods

Laboratory animals: 40 male Wistar rats were purchased from the Pasteur Institute and divided into 5 groups of 8: Sham group with a normal diet, palm oil group with 10% (W/W) palm oil diet, palm oil group with 20% (W/W) palm oil diet, ghee oil group 7.5% (W/W), heated palm oil group with 20% (W/W) palm oil diet. Then they were kept for 90 days. Then the rats were sacrificed. The weight of the rats in the beginning was 230 ± 20 . Next, the rats were kept in special cages at a temperature of 22 ± 2 degrees Celsius with 12 hours of light and 12 hours of dark photo cycle and food and water were available for them. All treatment works on rats have the approval of the ethics committee of Kermanshah University of Medical Sciences. Ethics number: IR.KUMS.REC.1398.099.

Experimental designing and grouping: The rats were randomly divided into five groups (eight rats in each group) and treated as bellows for 3 months after weighting. The groups were as follows:

- (1) Control group (A): Who ate the normal diet.
- (2) Palm oil group (B)1: In this group, animals were fed with 10% (W/W) palm oil diet.
- (3) Palm oil group 2 (C): In this group, animals were fed with 20% (W/W) palm oil diet.
- (4) Oil group (D): In this group, animals were fed with 7.5% (W/W) ghee oil diet.
- (5) Heated palm oil group 2 (E): In this group, animals were fed with a 20% (W/W) heated palm oil diet.

The heated palm was repeatedly heated 10 times at 180 degrees Celsius for 10 minutes (11).

2.1. Histological Study of Heart Tissue

After general anesthesia, the animals were sacrificed and their hearts were cut longitudinally and quickly fixed with 10% formaldehyde buffer solution. Tissues were processed and embedded with paraffin. Staining with hematoxylin and eosin (H&E) was done after cutting ($5 \mu\text{m}$ thickness). The histological analysis was done by a light microscope (100X) (8).

3. Results

Evaluation of microscopic images (Figure 1).

Significant changes were observed in the heated palm of 20% compared to the control group, that the nuclei of the cells shriveled and shrunk and contracted and finally became linear. Also, in the heated palm of 20%, the heart muscle was almost destroyed. Fat storage can also be seen in heart muscles, which can be seen in the form of vacuoles after tissue processing. Also, opening separation and disruption of stair discs were observed at the junctions of the muscles. In addition to the above, strengthening of the perimysium system was observed in the heated palm, so the number of connective tissue cells between the muscles was strengthened and increased. Unlike heart muscles, the connective tissue cells have larger and strengthened nuclei, and several macrophages and lymphocytes were also observed inside the heart muscles. Also, we did not see much sediment in the ghee group and compared to the 20% heated palm, vacuolar states were rarely observed by checking the changes in the ghee group compared to the control group. Therefore, comparing the tissues of the control group and ghee oil with the 20% heated palm showed that in the heated palm group, the amount of fat storage and its metabolism was disturbed. Also, in the ghee oil group, we observed the weakening of the perimysium system. Changes in the 10% group without heating compared to the control group showed the nuclei were almost similar to the control group, but they had a small amount of vacuolar. Therefore, a small amount of fat deposition has been observed in this group as well. Also, the perimysium system is weakened compared to the control group and a lower number of cells has been observed in the connective tissue. The changes in the 20% unheated group compared to the control group showed the number of vacuoles was slightly higher. Therefore, the fat deposition was somewhat higher than the 10% palm, the perimysium system was weakened and the connective tissue nuclei were also weakened.

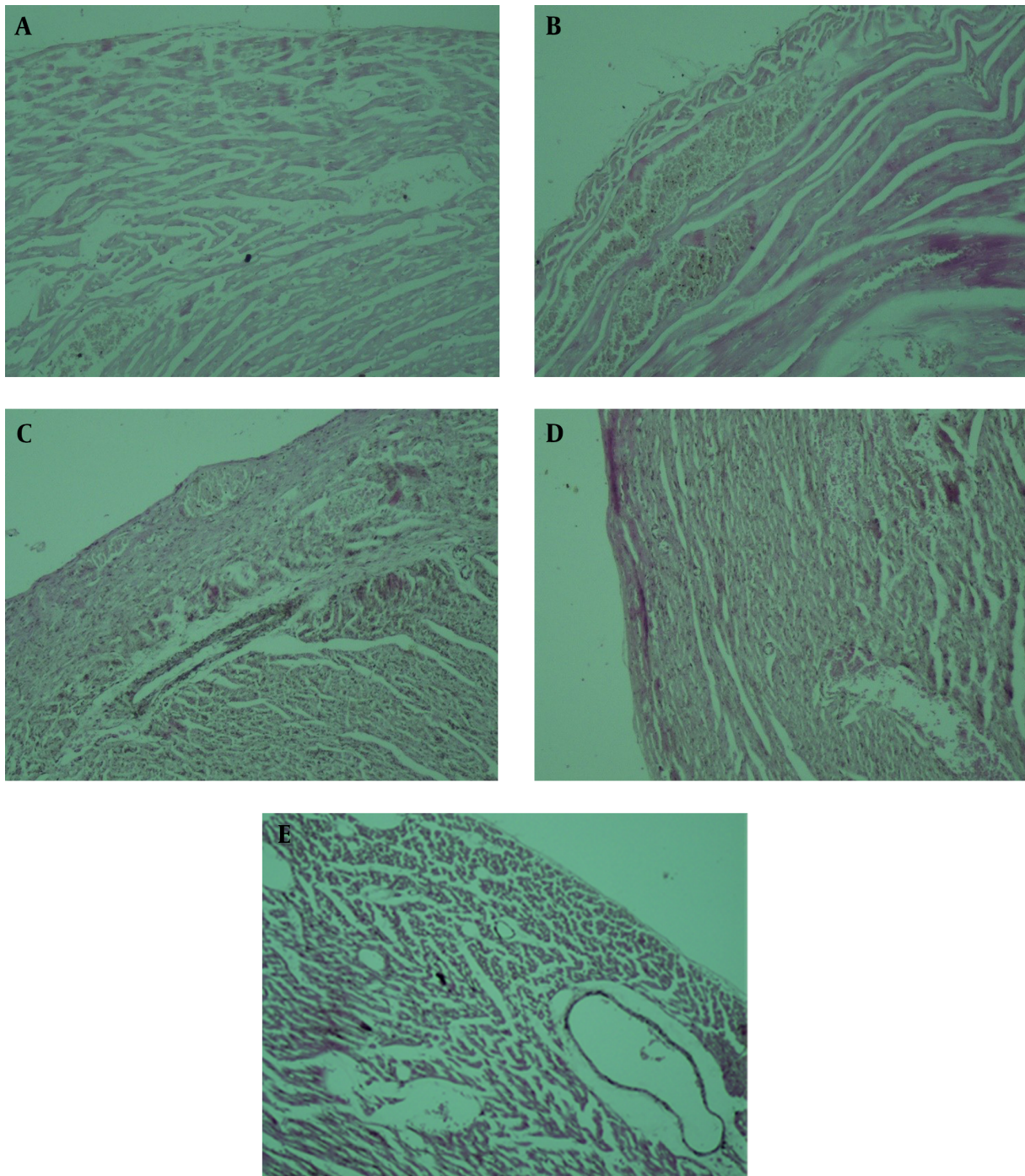


Figure 1. Control group (A); palm oil 10% (B); palm oil 20% (C); ghee oil (D); palm oil 20% heated (E)

4. Discussion

In this study, the effect of palm olein oil on the heart tissue of male rats was investigated. Body weight

values on the last day of the experiment show that there was a significant increase in the 20% heated palm oil group compared to the control group. However, the 10% and 20% unheated palm groups did not show any

difference compared to the control group, and there was no significant difference between the heated and unheated palm oil groups. This project was to investigate the heart tissue of male rats in different groups and it was a continuation of the project that was previously investigated by Zhaleh et al. (12).

Repeated heating of palm oil for a long time and high temperature causes the production of free radicals, and antioxidants such as vitamin E and carotenes are eventually destroyed during the heating process. The histological examination of the heart shows necrosis in the heart tissue in the heated groups, which means that repeated heating of palm oil causes a lot of damage to the heart and other organs. Long-term consumption of heated palm oil causes heart poisoning, which may be due to the production of a toxic substance by the oxidation that occurs in palm oil (13). The heart tissue provides blood circulation in the body using a large number of mitochondria, and the study has shown that cell degeneration is caused by biochemical factors and abnormal structural changes, and long-term cell degeneration leads to heart tissue necrosis. Cell degeneration is the same thing that happened in the heart tissue due to repeated heating of palm oil and we can see that the heart tissue was very damaged (14). Lipid peroxidation means oxidative degeneration of fats. This process of free radicals removes electrons from fats such as cell membrane lipids and turns fat into radicals, which is a chain reaction mechanism of free radicals; and it mostly affects unsaturated fatty acids. Free radicals cause lipid peroxidation, and as a result of lipid peroxidation, harmful substances are produced. The most important of them are aldehydes free radicals which can be generated in a wide variety of chemical and biological systems, including the formation of plastics, the aging of paints, the combustion of fuels, and the human body (15). Also, aldehydes aggravate the process of atherosclerosis and aging and are involved in the pathogenesis of many diseases. Antioxidants also prevent lipid peroxidation, and if antioxidants decrease, the amount of free radicals will increase which is followed by lipid peroxidation, and as a result, the effects of stress on the cardiovascular condition are intensified (16). Under stressful conditions, the capacity of antioxidants decreases, and as a result, the amount of oxidative stress increases and makes a person susceptible to the occurrence of physical diseases, especially diseases such as atherosclerosis. It is possible to reduce the harmful effects of stress on the body, especially the heart and blood vessels by antioxidants (17). Palm oil is rich in tocotrienols (T3s), a type of vitamin E that has attracted significant research attention because it has anti-inflammatory as well as antioxidant properties.

Also, T3 is not produced by the human body, so it must be consumed. Tocotrienol can prevent the release of various inflammatory mediators that contribute to age-related diseases by increasing oxidative stress. The antioxidant role of vitamin E in palm oil is very important for skin damage, as well as for preventing cardiovascular disease and stroke (18).

We have shown that fresh palm oil is not harmful, but long-term consumption of repeatedly heated palm oil may cause damage to cardiovascular tissue. Increasing the blood pressure in the heart tissue may be important for every person. Ghee oil not only does not hurt the heart tissue but also strengthens this tissue.

Footnotes

Authors' Contribution: Study concept and design: Mohsen Zhaleh; analysis and interpretation of data: Saman Moradi; drafting of the manuscript: Shayesteh Fathi.

Conflict of Interests: There is no conflict of interest.

Ethical Approval: All treatment works on rats have the approval of the ethics committee of Kermanshah University of Medical Sciences. Ethics number: [IR.KUMS.REC.1398.099](https://doi.org/10.3390/ma13010090).

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