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ADVANTAGES OF HIGH OLEIN SUNFLOWER OIL OVER PALM OIL ACCORDING TO BIOCHEMICAL RESEARCH RESULTS

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Abstract

Aim**:** to compare the effect of palm and high oleic sunflower oil (HOSO) on the biochemical parameters of the body of rats.

Methods: rats received food containing 15% palm oil or 15% HOSO for 41 days. The activity of elastase, urease, lysozyme, catalase, level of MDA determined in the tissues. The antioxidant-prooxidant index of API was calculated from the ratio of catalase activity and MDA level, and dysbiosis level was calculated from the ratio of relative activities of urease and lysozyme.

Results: was revealed an increase in elastase and urease activity, increase in dysbiosis level and level of MDA, decrease in the activity of catalase, lysozyme and API index, much more pronounced in animals that received palm oil.

Conclusion: high-fat diet causes the development of dysbiosis, decreased levels of protective enzymes (lysozyme and catalase) and increased levels of markers of inflammation (elastase and MDA). Palm oil has a stronger negative effect on the body. It is recommended to use high-oleic sunflower oil in food.

Keywords: *high-fat diet, palm oil, high-oleic sunflower oil, dysbiosis, inflammation, lysozyme, catalase*

Introduction

Recently, the consumption of fats by the population of Ukraine has increased significantly [1, 2], especially due to animal fats with high content of saturated fatty acids, in particular, palmitic (C16:0), which is considered to be harmful in the amount of more than 10% [3, 4]. Increased consumption of palmitic acid is not only due to animal fats, but also due to increased use of palm oil, which contains more palmitic acid than all animal fats [5, 6].

At the same time, was started production and consumption of a new vegetable oil, the so-called high-oleic sunflower oil (HOSO) containing a significant amount of oleic acid (over 75%; C18:1), which is considered harmless [7]. It is important to emphasize that HOSO contains very little amount of palmitic acid (less than 5%). According to this, HOSO is a more favourable oil than olive oil, which contains 3 times more palmitic acid [7].

Unfortunately, the production of HOSO is not enough to replace ordinary (high-linoleic acid) sunflower oil. However, this will need to be done because experts believe that the content of linoleic acid in consumption should be less than 10% [2].

Therefore, the aim of this work was to study condition of the body depending on the consumption of palm oil and HOSO. The activity of the proteolytic enzyme elastase [8] and the content of the end product of fat peroxidation - malonic dialdehyde (MDA) [11] were chosen as biochemical indicators of inflammatory and dystrophic processes. As an indicator of bacterial contamination, we chose the activity of the enzyme urease, which is not synthesized in the animal body and has an exclusively microbial origin [9]. The state of innate immunity was assessed by the activity of the enzyme lysozyme [10], and the state of antioxidant protection due to the activity of the enzyme catalase [11], as well as by determining the antioxidant-prooxidant index API [11]. According to the ratio of the relative activities of urease and lysozyme, the degree of dysbiosis was calculated according to AP Levitsky [9, 14].

Objective to compare the effect of palm and high oleic sunflower oil (HOSO) on the biochemical parameters of the body of rats.

Methods

Two fats were used in the present work: palm oil (Batter, Malaysia) and HOSO "Olivka" (created by SPA "Odessa Biotechnology", Ukraine). Experiments were performed using white Wistar rats, divided into 3 groups of 7 animals in each. The first, control group received standard feed. Second group received feed in which was introduced 15% of palm oil instead of corresponding amount of grain component and third group received feed in which 15% of HOSO was introduced instead of corresponding amount of grain component. Animals had free accesses to the feed and water. The duration of feeding was 41 days.

Animals were sacrificed under thiopental narcosis (20 mg / kg). Liver, kidneys, mucous membrane of the small intestine and blood serum were isolated. Active elastase [11], MDA change [11], urease [9] activity, lysozyme [9], catalase [11] were analysed in blood serum and tissue homogenates. Antioxidant-prooxidant index API was calculated according to the ratio of catalase activity and level of MDA [11]. Calculation of dysbiosis level was based on the ratio of relative activities of urease and lysozyme according to AP Levitsky [9]. The fatty acid composition of fats was analysed with the gas chromatographic method [13].

Acquired data were analysed with standard statistical processing [12].

Results

Results of fatty acids content analysis in the composition of palm oil and high-oleic sunflower oil "Olivka" presented in table 1. These data show that palmitic acid and oleic acid in the palm oil are the most prevalent. HOSO is characterised by the prevalence of oleic acid (88.66%), while the amount of palmitic acid is almost 10 times less than in palm oil. Both high-fat diets (HFD) cause a significant increase of the weight: 40% (compared to control) palm oil and 33% "Olivka" (Table 2).

Elastase activity considered to be the one of the main inflammatory markers. Results of elastase activity analysis in different tissues of animals that received HFD with the palm oil and oil "Olivka" respectively presented in the fig.1. Results showed that HFD with the palm oil leads to an increase in elastase activity in the liver, kidneys, mucous

membrane of the small intestine. At the same time results acquired in another group of animals that received HFD with high-oleic oil "Olivka" did not lead to an increase of this marker.

Fig. 2 shows the results of analysis of the second marker of inflammatory and degenerative processes - MDA, that is also can be used as indicator of lipid peroxidation (LPO) [2]. HFD with the palm oil leads to an increase of MDA in the liver, mucous membrane of the small intestine and blood serum. HFD with high-oleic oil "Olivka" also leads to an increase of MDA in the liver and mucous membrane of the small intestine, however this increase is less pronounced as in the group of animals that received HFD with the palm oil.

Fig. 3 presents the results of urease activity analysis in rat tissues that is considered to be an indicator of bacterial contamination. HFD with the palm oil leads to significant increase of the urease level in all tissues (in 2-4 times), while HFD with high-oleic oil leads to increase of the urease level only in the kidneys (1.8 times). Acquired results showed that high-fat nutrition causes microbial contamination of internal organs and blood.

Lysozyme is an antimicrobial enzyme that is used as marker of innate immunity [10]. Results of lysozyme activity analysis presented in fig.4. HFD with the palm oil leads to decrease of lysozyme activity in all studied tissues while HFD with HOSO leads to decrease of lysozyme activity only in the small intestine. Decrease of lysozyme activity can be one of the reasons of revealed microbial contamination.

Results of catalase (antioxidant enzyme) activity analysis performed in tissues of rats that received HFD presented in fig.5. Activity of this enzyme after HFD with the palm oil is significantly reduced in all tissues except the liver. However, HFD with "Olivka" leads to decrease of catalase activity only in the mucous membrane of the small intestine.

Fig. 6 shows the effect of HFD on the API index. The highest values of API were in the mucous membrane of the small intestine and serum. HFD with the palm oil leads to significant decrease of the API in all tissues, while HFD with "Olivka" leads to decrease of the API only in the liver. Acquired results reveal imbalance of antioxidant and prooxidant systems in favor of the latter.

Results of dysbiosis analysis in the tissues of rats that received HFD presented in fig.7. HFD with the palm oil leads to significant increase of the level of dysbiosis: in the liver 3 times, in the kidneys 3.8 times, in the mucous membrane of the small intestine 7 times and in the blood serum 7.6 times. At the same time, HFD with "Olivka" leads to not so pronounced increase of the level of dysbiosis: in the liver 1.3 times, in the kidneys 1.9 times, in the mucous membrane of the small intestine 3.5 times and in the serum 3.1 times.

Thus, HFD leads not only to obesity but also cause a number of biochemical changes in the body as it was evidenced by an increase of bacterial contamination and decrease of lysozyme level. This, in turn, lead to development of inflammatory and dystrophic processes on the body as it was revealed by upregulation of inflammatory markers: elastase activity and changes in MDA. It is important to emphasize that mentioned above pathological processes predominantly caused by the use of the palm oil containing the amount of palmitic acid 10 times higher than HOSO. Better outcomes revealed in experiments with HOSO caused by high level of oleic acid that does not have negative effects on the body.

Discussion

1. High-fat diet has a negative effect on the body, causing the development of dysbiosis, reduced levels of innate immunity and antioxidant protection, which leading to the development of inflammatory and dystrophic processes.

2. The pathogenic effect of high-fat diet largely depends on the fatty acid composition of dietary fats. Palm oil with a high content of palmitic acid has more pronounced negative effect than high-oleic sunflower oil, which contains 10 times less palmitic acid.

3. On the basis of acquired results, it is recommended to use high-oleic sunflower oil.

Conflict of interest

The authors declsre that there are no conflicts of interest.

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Table 1. The composition of fatty acids used fats (% of the amount of fatty acids)

Fatty acid	Short formula	Palm oil	High oleic sunflower oil
Lauric acid	$C_{12:0}$	0,19	0
Myristic acid	$C_{14:0}$	1,16	0,03
Palmitic acid	$C_{16:0}$	42,02	4,44
Stearic acid	$C_{18:0}$	4,87	3,07
Oleic acid	$C_{18:1}$	40,93	88,66
Linoleic acid	$C_{18:2}$	9,49	1,21
Linolenic acid	$C_{18:3}$	0,17	0,11
Arachinic acid	$C_{20:3}$	0,47	0,27
Eicosenic acid	$C_{20:1}$	0,16	0,16
Behenic acid	$C_{22:0}$	0,13	1,07
Lignoceric acid	$C_{24:0}$	0,10	0,81

Table 2. Relative weight increase of rats after 41 days of high-fat diet (n = 7 in each group)

№	Groups	Relative weight increase %
1	Control	27±2,9
2	Palm oil	38±3,3 p<0,05
3	High oleic sunflower oil «Olivka»	36±3,2 p<0,05

Figure 1. The effect of HFD on the activity of elastase in rat tissues
(1 - control, 2 - palm oil, 3 - high oleic sunflower oil)
***** - p <0,05 in comparison with gr. 1; ****** - p <0,05 in comparison with gr. 2.

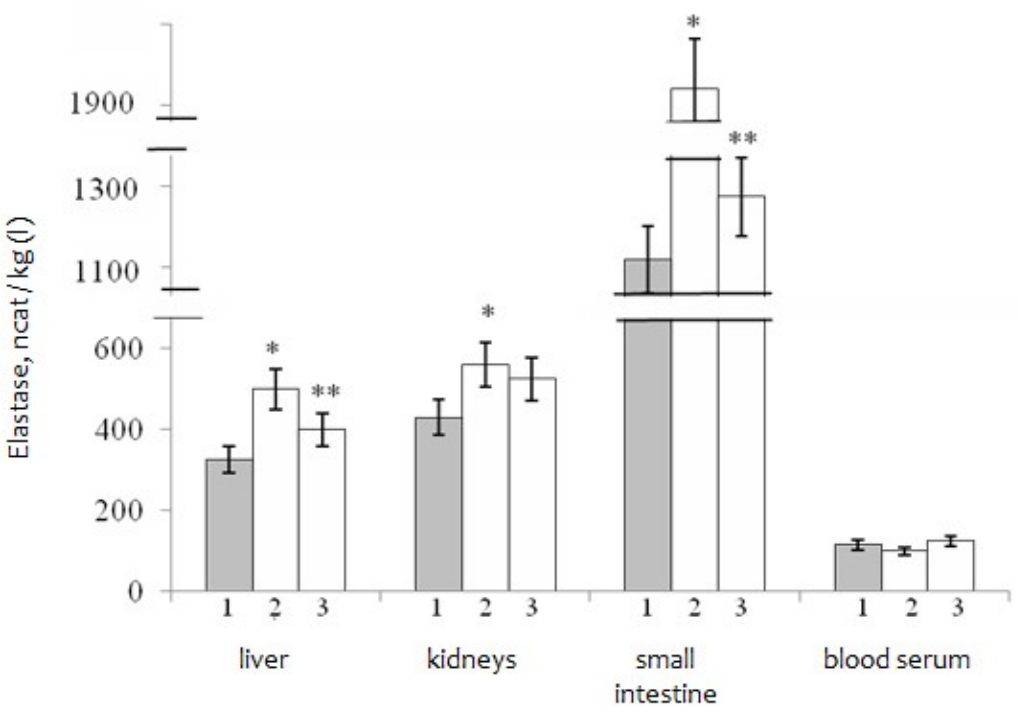

Figure 2. The effect of HFD on the MDA content in rat tissues (1-3 - see Fig. 1)
***** - p <0,05 in comparison with gr. 1; ****** - p <0,05 in comparison with gr. 2

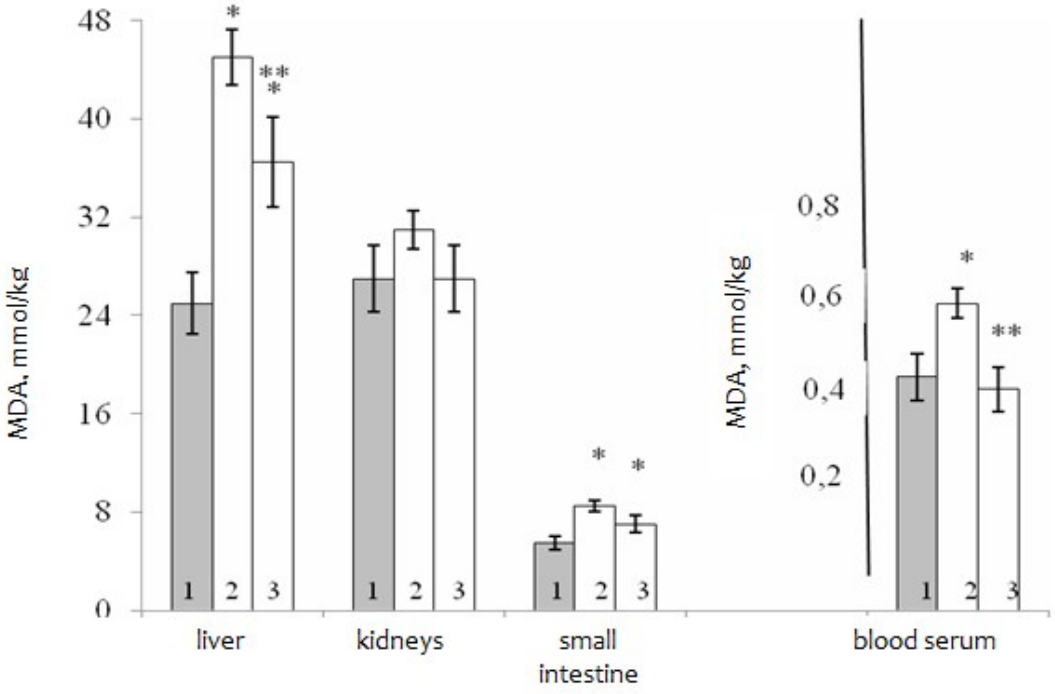

Figure 3. The effect of HFD on urease activity in rat tissues (1-3 - see Fig. 1)
***** - p <0,05 in comparison with gr. 1; ****** - p <0,05 in comparison with gr. 2

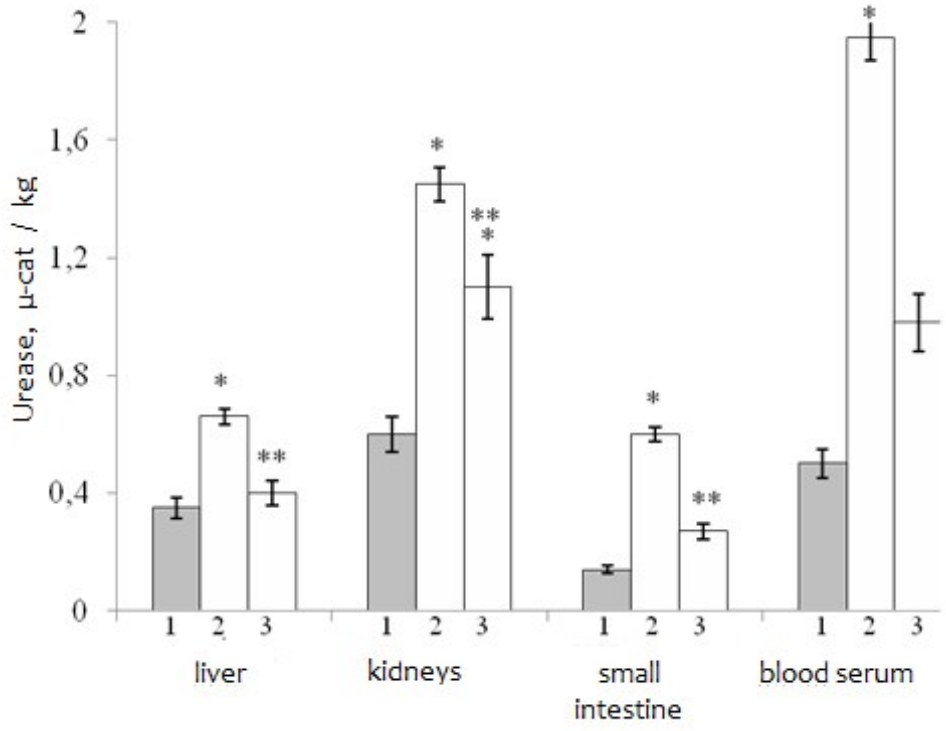

Figure 4. The effect of HFD on lysozyme activity in rat tissues (1-3 - see Fig. 1)
***** - p <0,05 in comparison with gr. 1; ****** - p <0,05 in comparison with gr. 2

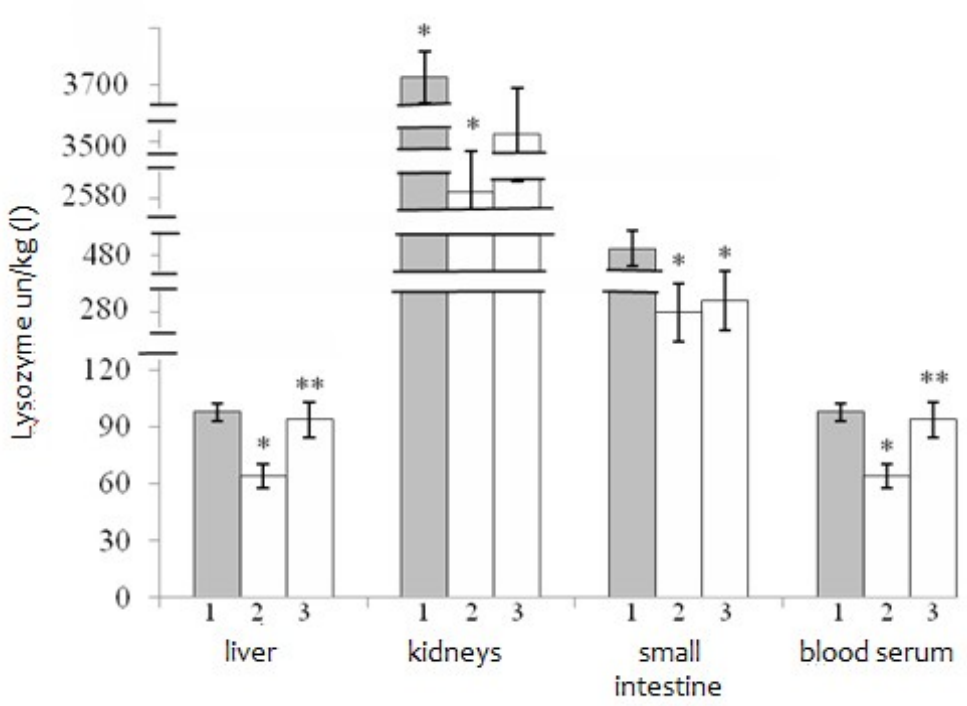

Figure 5. The effect of HFD on catalase activity in rat tissues (1-3 - see Fig. 1)
***** - p <0,05 in comparison with gr. 1; ****** - p <0,05 in comparison with gr. 2

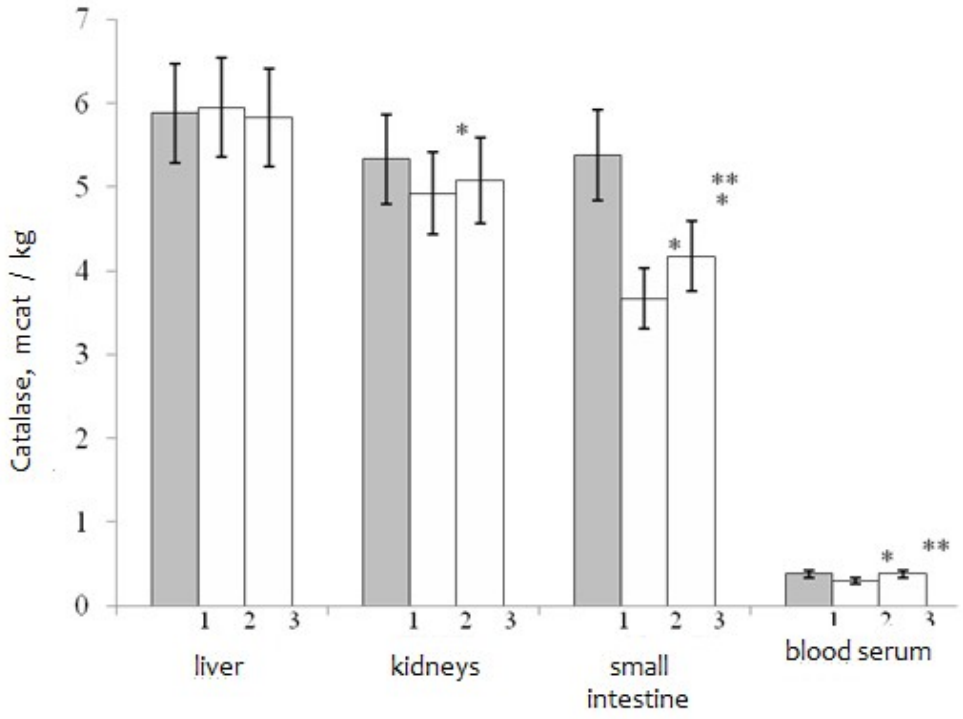

Figure 6. The effect of HFD on the level of API in rat tissues (1-3 - see Fig. 1) * - p <0,05 in comparison with gr. 1

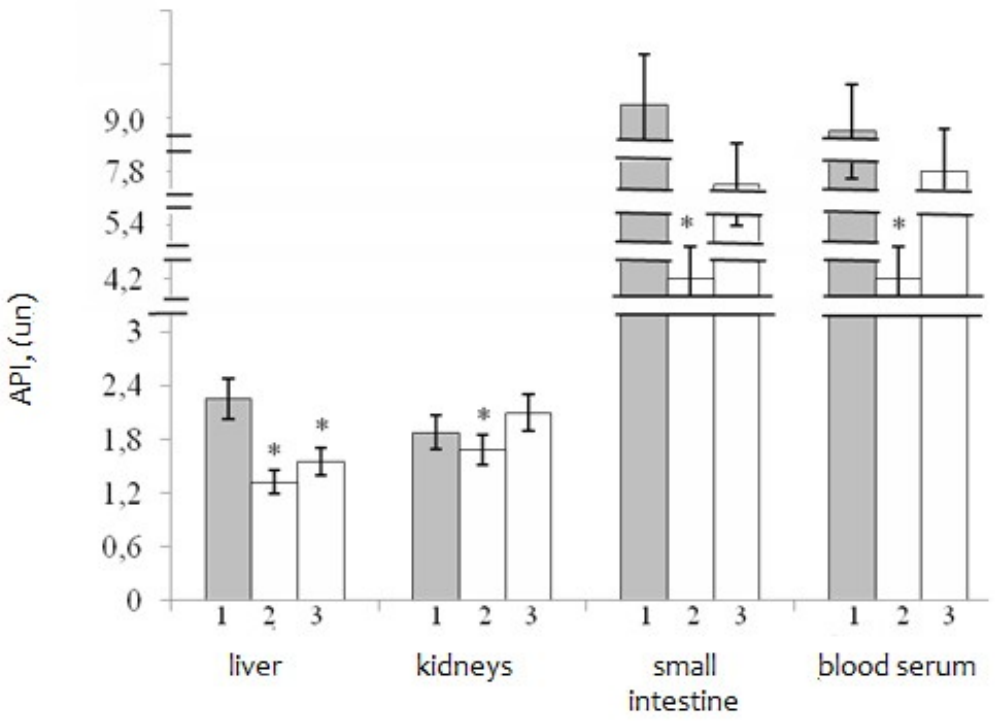

Figure 7. The effect of HFD on the level of dysbiosis in rat tissues (1-3 - see Fig. 1)
***** - p <0,05 in comparison with gr. 1; ****** - p <0,05 in comparison with gr. 2