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INFLUENCE OF ORAL PHYTOGELS ON BIOCHEMICAL INDICATORS OF BLOOD SERUM OF RATS TREATED WITH ORAL APPLICATIONS OF THERMOPEROXIDE SUNFLOWER OIL

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Abstract

Aim. It has been established that the consumption of thermoperoxide fats causes the development of pathological processes in the tissues of the oral cavity, intestines and liver. The purpose of this work: to investigate the effect of oral applications of thermal peroxide sunflower oil on the biochemical parameters of blood serum and to determine the possibility of their normalization using phytogels.

Methods Thermoperoxide sunflower oil (TPSO) was obtained by heating sunflower o.il in the presence of H_2O_2 at a temperature of +180° C for 60 minutes. Oral TPSO applications were performed on the oral mucosa of rats at a dose of 2.25 g/kg daily for 5 days. Used mucous-adhesive phytogels "Kvertulin" (quercetin + inulin), "Biotrit" (juice from wheat sprout) and "Dubovy" (extract of polyphenolic compounds from oak wood) in the form of oral applications at a dose of 2.25 g/kg for half an hour before TPSO applications daily for 5 days. Serum glucose, triglycerides, total cholesterol, malonic dialdehyde (MDA), elastase activity, alanine aminotransferase (ALT) catalase, alkaline phosphatase (ALP) and urease were determined.

Results. Oral TPSO applications increased serum levels of glucose, triglycerides, cholesterol, MDA, elastase, ALT, but reduced catalase activity. The application of phytogels has largely normalized these indicators.

Conclusion. Oral TPSO applications cause systemic inflammation and liver damage. Oral applications of phytogels have a protective effect, especially “Kvertulin”.

Keywords: *Thermal Peroxide Oil, Systemic Inflammation, Hepatitis, Phytogels, Oral Applications.*

Introduction

Under the conditions of high-temperature processing of food fats that contain unsaturated fatty acids, they produce toxic to the body products of thermoperoxidation [1-4].

Consumption of such thermoperoxide fats causes the development of pathological processes in the intestinal mucosa [5, 25] and oral cavity [6], in the periodontium [6, 7], liver [8].

Preventive effect in the consumption of thermoperoxide fats is carried out by oral applications of phytogels containing plant extracts rich in polyphenolic compounds [9-11, 26, 27].

It has been established that oral applications of thermoperoxide sunflower oil (TPSO) cause pathological changes not only in the tissues of the oral cavity, but also in the stomach, intestines and liver.

The condition of blood at conditions of oral applications of thermoperoxide fats remains unknown.

Therefore, the aim of this work was to determine the effect of oral applications of TPSO on the biochemical parameters of blood serum and to study the possibility of their prevention using oral phytogels with plant extracts.

As biochemical indicators, we chose the determination in the blood serum of the content of a number of metabolic factors (glucose, triglycerides, cholesterol), markers of systemic inflammation (elastase, MDA), liver markers (ALT, alkaline phosphatase), antioxidant defense system (catalase, API index), indicator bacteremia (urease).

Biotrit phytogel, which contains wheat sprout juice [12] and "Dubovy" phytogel, which contains phenolic compounds from oak wood [13], were used as oral phytogels. As a comparison drug was used phytogel "Kvertulin" [14].

The aim of our work is to investigate the effect of oral applications of thermal peroxide sunflower oil on the biochemical parameters of blood serum and to determine the possibility of their normalization using phytogels.

Materials and methods

Thermoperoxide sunflower oil (TPSO) was obtained by heating refined sunflower oil at a temperature of +180 °C for 60 minutes in the presence of 1.5 % H_2O_2 (30 % solution). TPSO contains 6 times more diene conjugates and almost 14 times more malonic dialdehyde (Fig. 1).

Phytogels "Biotrit", "Dubovy" and "Kvertulin" produced by SPA "Odessa Biotechnology" were used in the work [15].

The experiments were performed on 30 white Wistar rats (females, 4-5 months, live weight 210 ± 13 g), which were divided into 5 equal groups: 1st - control, 2nd, 3rd, 4th and group 5 received daily applications of TPSO at a dose of 0.5 ml per rat for 5 days. Rats of the 3rd group 30 minutes before the application of TPSO received the application of the phytogel "Kvertulin" in a dose of 0.5 ml, daily for 5 days. Rats of the 4th group received applications of the phytogel "Biotrit" in a similar way, and rats of the 5th group received applications of the phytogel "Dubovy" in a similar way.

Euthanasia of animals was performed on day 6 under thiopental anesthesia (20 mg/kg) by total bleeding from the heart. Received blood serum, in which determined the content of glucose [16], triglycerides [17], total cholesterol [17], the content of MDA [16], catalase activity [16], alanine aminotransferase (ALT) [18], alkaline phosphatase (ALP) [18], as well as the activity of the bacterial enzyme urease [19]. According to the ratio of catalase activity and MDA content, the antioxidant-prooxidant index of API was calculated [16].

Experimental studies were conducted in accordance with the rules established by the Directive of the European Parliament and the Council (2010/63 / EU), by the order of the Ministry of Education and Science, Youth and Sports of Ukraine No. 249 of March 1, 2012 "On Approval of the Procedure for conducting scientific experiments, experiments on animals by scientific institutions " and methodical recommendations.

The results of the experiments were subjected to standard statistical processing [20].

Results

Table 1 presents the results of determining the content in the serum of the following metabolites: glucose, triglycerides (fats) and cholesterol. These data show that oral applications of TPSO cause a significant increase in glucose (by 24 %), triglycerides (by 62 %) and cholesterol (by 40 %).

This suggests that the consumption of thermoperoxide sunflower oil, even in such small doses when administered orally (2.4 g/kg), causes serious metabolic disorders that can be observed in patients with atherosclerosis, type 2 of diabetes or metabolic syndrome.

Phytogels "Biotrit" and "Dubovy" show only a tendency to reduce glucose and cholesterol in contrast to the comparison drug "Kvertulin", which completely normalizes the content of glucose and triglycerides, and even significantly reduces cholesterol by 33 % compared to control.

Phytogel "Biotrit" has almost no effect on the level of triglycerides, while phytogel "Dubovy" significantly reduces it.

Table 2 presents the results of determining biochemical markers of systemic inflammation, namely elastase activity and MDA content. It is seen that the level of both indicators in the serum increases significantly: the activity of elastase by 43% and the content of MDA by 16%, which may indicate the development of systemic inflammation [21]. All three phytogels reduce the activity of elastase: "Biotrit" by 34 %, "Dubovy" by 31 % and "Kvertulin" by 53 %, and the phytogel "Kvertulin" is even below control. The serum content of MDA is significantly reduced only by phytogels "Kvertulin" and "Biotrit".

Table 3 presents the results of determination of serum markers of liver in the blood, namely the activity of ALT and ALP. It is seen that in rats treated with oral TPSO, significantly increases the level of ALT (40.6 %) and the level of ALP (14.1 %, $p>0.05$), which indicates the defeat of hepatocytes and a certain tendency to develop cholestasis.

All three phytogels significantly reduce the activity of ALT, and no significant difference in the action of phytogels was found. There was also no significant effect of phytogels on the activity of ALP.

The obtained data testify to the hepatoprotective efficiency of the phytogel "Dubovy", which is not inferior to the phytogel "Kvertulin".

In fig. 2 shows a tendency to increase serum urease activity, which may indicate the presence of bacteremia, and all three phytogels do not significantly affect this indicator.

Table 4 presents the results of determining the serum activity of the antioxidant enzyme catalase and the level of the API index. These data show that oral applications of TPSO significantly reduce both indicators: catalase activity by 27.3 % and API index by 37.5 %. Oral applications of phytogels increase the activity of catalase and to a greater extent after applications of "Kvertulin" and phytogel "Dubovy". All three phytogels normalize the API index, and to the greatest extent "Kvertulin".

The data obtained may indicate an increase in lipid peroxidation after oral administration of TPSO, which itself contains a significant amount of MDA.

Thus, our studies raise an important question about the pathogenic effect of thermoperoxidated fats, the consumption of which is growing every year. It is possible that current trends in the growth of metabolic diseases among the population of Ukraine depend to some extent on a further increase in consumption of fatty foods after heat treatment.

Considering the fact that it is very difficult to change people's taste preferences, we propose the use of phytogels, which to a large extent prevent the development of pathological complications from the consumption of such products. Of the three phytogels studied by us, "Kvertulin" was the most effective, which includes the bioflavonoid quercetin, which is the most active antioxidant and membrane protector [22]. Inulin, which is part of "Kvertulin", is the most active prebiotic that eliminates dysbiosis [23], in which the liver suffers the most [24].

Conclusions

1. Oral applications of thermoperoxide sunflower oil (TPSO) cause the development of metabolic disorders and systemic inflammation in the body.
2. Preliminary oral applications of phytogels, which contain antioxidants and prebiotics, have a preventive effect when consuming TPSO.
3. The most effective phytogel was "Kvertulin".

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The authors declsre that there are no conflicts of interest.

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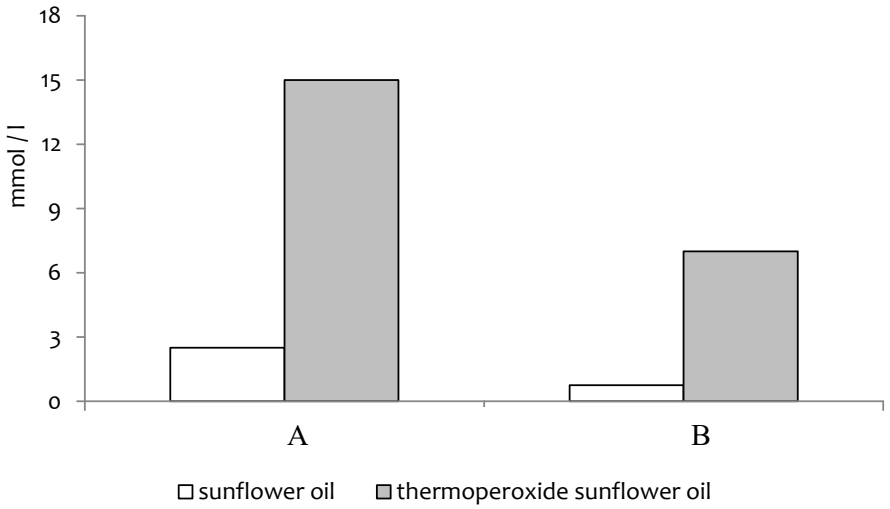

Figure 1. The content of diene conjugates (A) and malonic dialdehyde (B) in thermoperoxide sunflower oil

Table 1. The effect of phytogels on the metabolic parameters of the serum of rats treated with oral applications of thermoperoxide sunflower oil (n = 6 in all groups)

№№	Groups	Glucose, mmol/l	Triglycerides, mmol/l	Total cholesterol, mmol/l
1	Control	7,2±0,2	0,34±0,01	0,85±0,05
2	Thermoperoxide sunflower oil (TPSO)	8,9±0,3 p<0,01	0,55±0,03 p<0,01	1,20±0,09 p<0,05
3	TPSO + «Kvertulin»	7,1±0,3 p>0,5; p_1<0,01	0,35±0,02 p>0,5; p_1<0,01	0,57±0,05 p<0,05; p_1<0,01
4	TPSO + «Biotrit»	8,1±0,4 p<0,05; p_1>0,05 p_2<0,05	0,48±0,02 p<0,01; p_1>0,05 p_2<0,05	1,00±0,06 p>0,05; p_1>0,05 p_2<0,05
5	TPSO + «Dubovy»	8,1±0,4 p<0,05; p_1>0,05 p_2<0,05	0,41±0,02 p<0,05; p_1<0,05 p_2<0,05	0,98±0,08 p>0,05; p_1>0,05 p_2<0,05

Notes: p - in comparison with gr. 1; p1 - in comparison with gr. 2; p2 - in comparison with gr. 3.

Table 2. The effect of phytogels on the level of markers of systemic inflammation in the serum of rats treated with oral applications of thermoperoxide sunflower oil (n = 6 in all groups)

№№	Groups	Elastase, mk-cat/l	MDA, mmol/l
1	Conrtol	120±5	0,61±0,04
2	Thermoperoxide sunflower oil (TPSO)	172±4 p<0,001	0,71±0,01 p<0,05
3	TPSO + «Kvertulin»	81±7 p<0,05; p_1<0,001	0,54±0,02 p<0,05; p_1<0,01
4	TPSO+ «Biotrit»	113±8 p>0,3; p_1<0,01 p_2<0,05	0,58±0,02 p>0,05; p_1<0,01 p_2>0,05
5	TPSO + «Dubovy»	118±6 p>0,5; p_1<0,01 p_2<0,05	0,69±0,02 p<0,05; p_1>0,3 p_2<0,05

Notes: see table. 1.

Table 3. The effect of phytogels on the activity of liver markers in the serum of rats treated with oral applications of thermoperoxide sunflower oil (n = 6 in all groups)

№№	Groups	ALT, mk-cat/l	ALP, mk-cat/l
1	Control	0,32±0,01	1,70±0,18
2	Thermoperoxide sunflower oil (TPSO)	0,45±0,03 p<0,05	1,94±0,12 p>0,05
3	TPSO + «Kvertulin»	0,33±0,03 p>0,3; p_1<0,05	1,75±0,12 p>0,3; p_1>0,3
4	TPSO + «Biotrit»	0,38±0,02 p<0,05; p_1<0,05 p_2>0,05	1,86±0,15 p>0,3; p_1>0,03 p_2>0,3
5	TPSO + «Dubovy»	0,34±0,02 p>0,05; p_1<0,05 p_2>0,5	1,87±0,14 p>0,3; p_1>0,3 p_2>0,3

Notes: see table. 1.

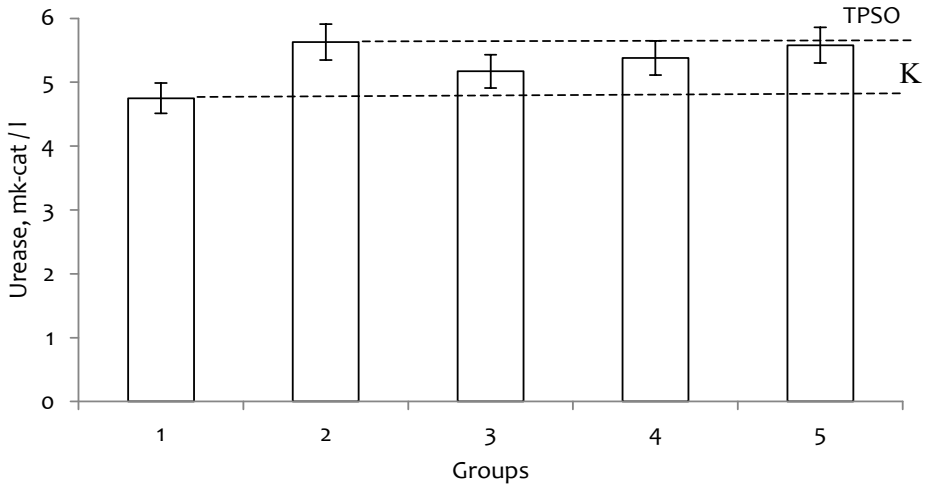

Figure 2. The effect of phytogels on the activity of urease in the serum of rats treated with thermoperoxide sunflower oil (TPSO) (1 – control; 2 – TPSO; 3 – TPSO + "Kvertulin"; 4 – TPSO + "Biotrit"; 5 – TPSO + "Dubovy")

Table 4. The effect of phytogels on catalase activity and API index in the serum of rats treated with oral applications of thermoperoxide sunflower oil (n = 6 in all groups)

№№	Groups	Catalase, mcat/l	API, unit
1	Control	0,33±0,02	5,41±0,34
2	Thermoperoxide sunflower oil (TPSO)	0,24±0,01 p<0,01	3,38±0,28 p<0,05
3	TPSO + «Kvertulin»	0,30±0,01 p>0,05; p_1<0,05	5,55±0,50 p>0,3; p_1<0,05
4	TPSO + «Biotrit»	0,28±0,02 p>0,05; p_1>0,05 p_2>0,3	4,83±0,39 p>0,05; p_1<0,05 p_2>0,05
5	TPSO + «Dubovy»	0,30±0,02 p>0,3; p_1>0,05 p_2=1	4,35±0,41 p>0,05; p_1<0,05 p_2>0,05

Notes: see table. 1.