Levitsky A. P., Markov A. V., Pupin T. I., Selivanskaya I. A., Lapinskaya A. P. Therapeutic and preventive effect of feed additives on the state of periodonts of rats with experimental dysbiosis. Journal of Education, Health and Sport. 2021;11(11):194-200. eISSN 2391-8306. DOI http://dx.doi.org/10.12775/JEHS.2021.11.11.018
https://apcz.umk.pl/JEHS/article/view/JEHS.2021.11.11.018
https://zenodo.org/record/5754054

The journal has had 5 points in Ministry of Science and Higher Education parametric evaluation. § 8. 2) and § 12. 1. 2) 22.02.2019.

The authors declare that there is no conflict of interests regarding the publication of this paper.

Received: 10.10.2021. Revised: 22.10.2021. Accepted: 30.11.2021.

UDK 615.244:616.34:616.921

THERAPEUTIC AND PREVENTIVE EFFECT OF FEED ADDITIVES ON THE STATE OF PERIODONTS OF RATS WITH EXPERIMENTAL DYSBIOSIS

A. P. Levitsky[1], A. V. Markov[2], T. I. Pupin[2], I. A. Selivanskaya[3], A. P. Lapinskaya[1]

[1]Odessa National Technological University
[2]Danylo Halytsky Lviv National Medical University
[3]Odessa National Medical University

Abstract

Aim. Determine the therapeutic and prophylactic effect of feed additives on the condition of the periodontium in case of dysbiosis.

Methods. As feed additives, we used flour from pea straw (FPS), oilcake from ordinary (high-linoleic) sunflower seeds (OOS) and oilcake from high-oleic sunflower seeds (OHOS), which were added to the composition of feed for rats in an amount of 10% instead of the same amount of grain wheat. The duration of feeding was 18 days. Experimental dysbiosis was reproduced using the antibiotic lincomycin. The activity of urease, lysozyme, catalase, elastase and the content of malondialdehyde (MDA) were determined in the gums of rats.

Results. An increase in the level of urease, elastase, MDA and a slight decrease in the activity of lysozyme and catalase were found in rats with dysbiosis. The consumption of FPS and OOS had little effect on the biochemical parameters of the gums; however, the

consumption of OHOS significantly reduced the activity of elastase, the level of MDA and normalized the level of urease.

Conclusion. Under conditions of dysbiosis, periodontitis develops, which can be prevented by consuming high-oleic sunflower oilcake.

Key words: dysbiosis, periodontium, feed additives, high-oleic sunflower cake, periodontal protection.

Introduction

In our studies, it was shown that the administration of the antibiotic lincomycin causes the development of a dysbiotic syndrome in rats with a predominant lesion of the colon mucosa and also the liver [1, 2]. Consumption of feed additives (flour from pea straw (FPS), cakes from seeds of ordinary (high-linoleic) or from seeds of high-oleic sunflower (OHOS) have a certain therapeutic and prophylactic effect, more pronounced in high-oleic oilcake [3, 4].

The purpose of this study was to determine the pathogenic effect of the state of dysbiosis on the periodontium of rats and also to determine the possible therapeutic and prophylactic effect of the above feed additives.

Material and research methods

The chemical composition of feed additives is presented in Table 1, from which it can be seen that oilcake, in contrast to FPS, contains a lot of protein and fat. The fundamental difference between the oilcakes lies in the fatty acid composition of the oil: a high (84.7 %) content of oleic acid and a very low content of linoleic acid in the fat of the OHOS.

Table 1. The content of protein, fat and fiber in feed additives (%)

Indicators	Flour from pea straw FPS	Oilcake of ordinary sunflower OOS	Oilcake of high-oleic sunflower OHOS
Protein	9,1	34,2	33,3
Fat	0,7	9,1	8,9
Fiber	41,3	39,2	38,7
Oleic acid (% of the amount of fatty acids)	–	29,2	84,7
Linoleic acid (% of the amount of fatty acids)	–	54,6	3,6

The experiments were carried out on 25 white Wistar rats (males, 2-2.5 months, average live weight 193±13 g), distributed in 5 equal groups (Table 2). Feed additives in the

amount of 10% were introduced into the diet instead of 10 % wheat grain. Experimental dysbiosis was induced by introducing the antibiotic lincomycin with drinking water at a dose of 70 mg / kg daily during the first 5 days of the experiment. The rats were fed for 18 days.

Table 2. The composition of rations for rats (%)

Components	Groups				
	1 Control	2 Dysbiosis (D)	3 D + FPS	4 D + OOS	5 D + OHOS
Wheat grain	85	85	75	75	75
Ovalbumin	10	10	10	10	10
Mineral mixture [5]	4	4	4	4	4
Vitamin mixture [5]	1	1	1	1	1
Flour from pea straw (FPS)	0	0	10	0	0
Oilcake of ordinary sunflower (OOS)	0	0	0	10	0
Oilcake of high-oleic sunflower (OHOS)	0	0	0	0	10

After euthanasia of animals under thiopental anesthesia (20 mg / kg), the gum was isolated, in the homogenate of which the activity of urease, lysozyme, catalase, elastase, as well as the content of malondialdehyde (MDA) was determined using the methods presented in the manual [5]. The antioxidant-prooxidant index of API was calculated from the ratio of catalase activity and MDA content [5], and the degree of dysbiosis was calculated from the ratio of the relative activities of urease and lysozyme [5].

The pathogenic effect (PE) on the periodontium of dysbiosis was determined by the sum of deviations from the control (in %) of biochemical parameters, and the therapeutic effect (TE) of feed additives was determined by the sum of deviations (in %) of biochemical parameters from the parameters in the periodontium of rats with dysbiosis. The ratio of PE and TE was used to calculate the therapeutic and prophylactic efficacy (TPE) of feed additives.

Statistical processing of the results was carried out by conventional methods [8].

Results and discussion

Table 3 shows the results of determining the activity of urease, lysozyme and the degree of dysbiosis in the gums. From these data, it can be seen that in rats receiving lincomycin, the activity of urease significantly increases (by 93.55 %) and the activity of lysozyme slightly decreases (by 13.89 %, but $p>0.05$). The consumption of feed additives

reduces the activity of urease: FPS by 41.25 %, OOS by 28.75 % and OHOS by 46.75 %, however, only high-oleic oilcake normalizes the level of urease.

Table 3. The effect of feed additives on the activity of urease, lysozyme and the degree of dysbiosis in the gums of rats with experimental dysbiosis

№№	Groups	Urease, μ-cat / kg	Lysozyme, units / kg	The degree of dysbiosis
1	Control	0,31±0,03	216±14	1,00±0,17
2	Experimental dysbiosis (ED)	0,60±0,12 p<0,05	186±15 p>0,05	2,26±0,29 p<0,05
3	ED + FPS	0,47±0,08 p<0,05; p_1>0,3	200±11 p>0,3; p_1>0,3	1,63±0,22 p<0,05; p_1>0,05
4	ED + OOS	0,57±0,29 p<0,05; p_1>0,5 p_2>0,3	203±14 p>0,3; p_1>0,05 p_2>0,5	1,96±0,24 p<0,05; p_1>0,3 p_2>0,3
5	ED + OHOS	0,43±0,40 p>0,05; p_1>0,05 p_2>0,5; p_3>0,5	204±15 p>0,3; p_1>0,1 p_2>0,5; p_3>0,8	1,46±0,21 p>0,05; p_1<0,05 p_2>0,3; p_3>0,1

Notes: p - in comparison with gr.1; p1 - in comparison with gr. 2; p2 - in comparison with gr. 3; p3 - in comparison with gr. 4.

The activity of lysozyme shows only a tendency to increase in rats receiving feed additives.

The increased degree of dysbiosis with the introduction of lincomycin normalizes only the consumption of feed with the introduction of high oleic oilcake.

Table 4 shows the results of determining the activity of the antioxidant enzyme catalase and the API index in the gums.

Table 4. The effect of feed additives on catalase activity and antioxidant-prooxidant API index in the gums of rats with experimental dysbiosis

№№	Groups	Catalase, mcat / kg	API
1	Control	8,90±0,14	5,67±0,24
2	Experimental dysbiosis (ED)	8,23±0,60 p>0,05	3,31±0,20 p<0,01
3	ED +FPS	8,59±0,48 p>0,3; p_1>0,3	3,62±0,27 p<0,05; p_1>0,3
4	ED + OOS	8,73±0,35 p>0,3; p_1>0,3 p_2>0,3	4,73±0,30 p<0,05; p_1____ p_2<0,05
5	ED + OHOS	8,80±0,32 p>0,5; p_1>0,3 p_2>0,3; p_3>0,5	5,24±0,29 p>0,05; p_1<0,05 p_2<0,05; p_3>0,3

Notes: see table 3.

It can be seen that the activity of catalase changes little with dysbiosis and the consumption of feed additives. However, the API index significantly decreases in rats with dysbiosis and returns to normal only in rats receiving high-oleic oilcake.

Table 5 shows the results of determining biochemical markers of inflammation in the gums: elastase activity and MDA content. It can be seen that with dysbiosis, the level of both markers of inflammation increases: elastase by 52.7 %, MDA by 58.15 %. The consumption of FPS has little effect on these indicators; the consumption of OOS reliably reduces only the MDA level, while the consumption of OHOS significantly reduces the level of both markers.

Table 5. The effect of feed additives on the level of markers of inflammation in the gums of rats with experimental dysbiosis

№№	Groups	Elastase, μ-cat / kg	MDA, mmol / kg
1	Control	42,6±4,5	15,71±1,45
2	Experimental dysbiosis (ED)	62,7±3,6 $p<0,01$	24,84±0,46 $p<0,01$
3	ED + FPS	58,9±3,6 $p<0,05$; $p_1>0,3$	23,12±2,15 $p<0,01$; $p_1>0,3$
4	ED + OOS	59,0±3,3 $p<0,05$; $p_1>0,3$ $p_2>0,5$	18,46±1,21 $p>0,1$; $p_1<0,05$ $p_2<0,05$
5	ED + OHOS	48,3±3,0 $p>0,3$; $p_1<0,05$ $p_2<0,05$; $p_3<0,05$	16,79±2,19 $p>0,3$; $p_1<0,05$ $p_2<0,05$; $p_3>0,3$

Notes: see table 3.

The pathogenic effect (PE) of dysbiosis on the periodontium was estimated as the sum of an increase (in %) in the level of pathogenicity markers (urease, elastase, MDA) and a decrease (in %) in the level of protective factors (lysozyme and catalase) and amounted to 225.82 %. The therapeutic effect (TE) of feed additives on the periodontal condition in dysbiosis was assessed as the sum of a decrease (in %) in the level of pathogenicity markers and an increase (in %) in the level of protective factors and amounted to 63.72 % for FPS, 75.54 % for OOS and for OHOS 118.24 % (see fig.).

Therapeutic and prophylactic efficacy (TPE) of feed additives in the periodontoprotective effect in dysbiosis turned out to be equal to 28.2 % for FPS, 33.5 % for OOS, and 52.4 % for OHOS.

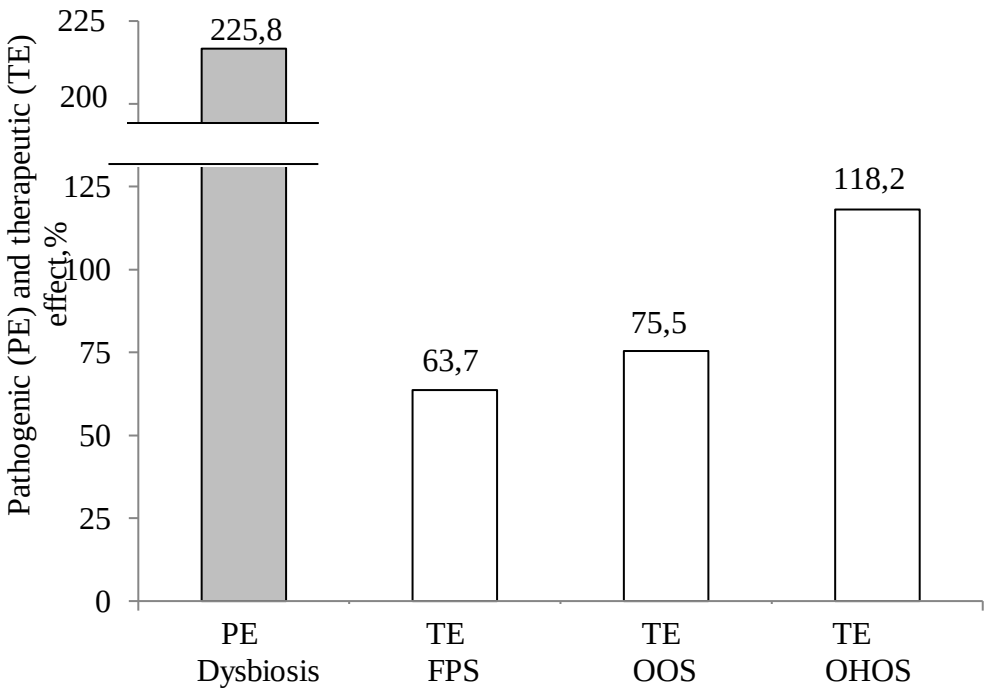

Fig. Pathogenic effect of dysbiosis and therapeutic effect of feed additives on the gums of rats

Conclusions

1. The introduction of lincomycin into the body causes the development of dysbiosis and inflammation in the periodontium.

2. Consumption of feed additives (FPS, OOS and OHOS) reduces the pathogenic effect of lincomycin on the periodontium, which is more pronounced for OHOS.

3. It can be assumed that the higher therapeutic and prophylactic efficacy of OHOS is due to the high content of oleic acid.

References

1. Levitsky AP. Disbiotic syndrome: etiology, pathogenesis, clinic, prevention and treatment. Dentistry Bulletin. 2019;10:14-20. (in Russian)

2. Levitsky AP, Lisnichuk MV, Zubachik VM. The substantiation of pathogenic role of dysbiotic conditions of oral cavity at gingivitis occurence at the experiment. Experimental and clinical phyzyology and biochemistry. 2008; 2 (42):28-31. (in Ukrainian)

3. Levitsky AP, Lapinska AP, Sichkar VI [and others]. Prospects for the use of pea straw in the production of mixed feed products. Cereals and compound feed. 2018;18(1-2):39-44. (in Ukrainian)

4. Levitsky AP, Selivanskaya IA, Sichkar VI [and others]. Antidysbiosis effect of soy straw flour. Cereals and compound feed. 2013; 2(50): 16-18. (in Russian)

5. Levitsky AP, Makarenko OA, Demyanenko SA. Methods of experimental dentistry (teaching aid). Simferopol, Tarpan, 2018:78. (in Russian)

6. Ermakov AI. Biochemical research methods of plants. Leningrad, 1987:430. (in Russian)

7. Levitsky AP, Makarenko OA, Khodakov IV. Methods to investigate fats and oils. Odessa. 2015:32. (in Russian)

8. Truhacheva NV. Mathematical Statistics in biomedical research using application package Statistica. Moskow, GJeOTAR-Media, 2012:379. (in Russian)