

EFFECT OF RATIONS ON THE DEVELOPMENT OF EXCESSIVE BODY WEIGHT OF MEDIUM-BREED DOGS

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According to current research of medical and veterinary scientists and practitioners, primary obesity (nutritional) is usually the result of excessive consumption of easily digestible products (feeds) in the background of malaise. That is why we have studied the influence of rations of different quality on the development of excess body weight. The influence of excessive and unnormal feeding of domestic dogs of medium breed (pug) on rations of various classes on the metabolism of lipids and proteins, as well as morphometric characteristics, was investigated. For four months, an experiment was conducted on the influence of dosage of rations of various classes (natural, industrial rations of super-premium and economy classes) on changes in the appearance of animals (deposition of abdominal fat) and the state of metabolism of proteins and fats of domestic dog breeds of pugs. At the beginning of the study, two months and four months later, clinical studies, morphometric calculations, biochemical studies of serum (serum definitions of total protein and fractions, triglycerols, total cholesterol, high, low and very low density

lipoprotein) were obtained. During the study we have established deterioration of blood serum values in animals for feeding with fodder economy class, even normalized. After the second stage of the experiment on the background of hyperproteinemia and increase in body weight of dogs in 1.22 times, the state of lipid metabolism deteriorated to a greater extent, compared with the indices after the I-th stage. In the blood serum of dogs, the concentration of triglycerols and LVLД in 1.31 times, total cholesterol and LLD in the 1.2 and 1.57 times has increased, respectively. At the end of the second stage of the experiment, as morphometric (body mass increase in 1.14 times), the biochemical parameters of the dogs also have undergone certain changes: the protein content of the blood serum has increased; the level of triglycerides, total cholesterol and LHD has increased in 1.31, 1.23 and 1.23 times, respectively. The possibility of the development of alimentary obesity in dogs of rocks of the average size, namely the pug species was experimentally proved. Dogs have constant access to the feed, regardless of the class and type of rations. The morphometric indices and biochemical characteristics of blood serum of domestic dogs of pups breed for excessive fatness are offered. The obtained research results should be used for practicing doctors of veterinary medicine, as well as in educational activities - to promote rational and dosage feeding of animals.

Keywords: *irrational feeding, fattening, pug, biochemical research, metabolic disorder.*

ВПЛИВ РАЦІОНІВ НА РОЗВИТОК НАДМІРНОЇ МАСИ ТІЛА СОБАК ПОРІД СЕРЕДНЬОГО РОЗМІРУ

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У статті наведені дані стосовно впливу надмірної та ненормованої годівлі свійських собак породи мопс за раціонів різних класів на метаболізм ліпідів і білків, а також на характеристики вгодованості. Обрана порідна спрямованість зумовлено значною поширеністю мопсів серед населення України та схильністю до надмірного споживання корму, а отже до накопичення надмірної маси тіла. Впродовж чотирьох місяців проведений експеримент щодо впливу дозованості раціонів різних класів (натуральний, промислові раціони супер-преміум та економ класів) на зміни зовнішнього вигляду тварин (відкладання абдомінального жиру) та стан метаболізму білків та жирів свійських собак породи мопс. На початку дослідження, через два місяці та через чотири місяці проводили клінічні дослідження, оцінку вгодованості, біохімічні дослідження сироватки крові (визначення у сироватці крові вмісту загального білка та його фракцій, тригліцеролів, холестеролу загального, ліпопротеїдів високої, низької та дуже низької густини), отримані дані обробляли статистично. У результаті надмірної неконтрольованої годівлі у собак за реєстрували наявність гіперпротеїнемії, що проявлялось підвищенням рівня загального білка в сироватці крові усіх 3-х груп тварин у 1,13, 1,16 та 1,12 раза, відповідно. Аналіз протеїнограми показав, що підвищення вмісту загального білка в сироватці крові виникав за рахунок підвищення рівня білків фракції альбумінів у 1,15, 1,28 та 1,14 раза, відповідно. За застосування раціону економ класу у вільному доступі на тлі гіперпротеїнемії та зростання маси. У сироватці крові собак достовірно підвищилась концентрація тригліцеролів та ЛПДНГ у 1,31 раза, холестеролу загального та ЛПНГ у 1,26 та 1,57 раза, відповідно. Важливим є відсутність достовірних змін щодо рівня ЛПВГ у сироватці крові собак, що свідчить про відсутність компенсаторного посилення зворотного шляху холестеролу із тканин і стінок судин у печінку. У собак, які утримувались на раціоні 3 (натуральний), наприкінці I-го етапу експерименту не було встановлено негативних змін морфометричних показників, а також показників обміну білків і ліпідів, як і за вживання раціону 1. По закінченню II-го етапу

експерименту, як морфометричні (зростання маси тіла в 1,14 раза), так і біохімічні показники собак зазнавали певних змін: зростав вміст білків; рівень тригліцеролів, холестеролу загального та ЛПВГ збільшувався в 1,31, 1,23 та 1,23 раза, відповідно.

Такі зміни метаболізму в подальшому можуть спричинити розвиток ожиріння та іншої супутньої внутрішньої патології. Одержані результати є важливими для сучасної ветеринарної практики як елемент експериментально-доказової науки, що дозволить вести ефективну просвітницьку діяльність серед населення по профілактиці ожиріння у собак.

Ключові слова: нераціональна годівля, вгодованість, мопс, біохімічні дослідження, порушення метаболізму.

ВПЛИВ РАЦІОНІВ НА РОЗВИТОК НАДМІРНОЇ МАСИ ТІЛА СОБАК ПОРІД СЕРЕДНЬОГО РОЗМІРУ

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В статье приведены результаты исследований о влиянии избыточного и ненормативного кормления собак породы мопс рационами различных классов на метаболизм липидов и белков, а также на характеристики упитанности. Выбор породной направленности обусловлено значительной распространенностью мопсов среди населения Украины и склонностью собак этой породы к чрезмерному потреблению корма, а следовательно к накоплению избыточной массы тела. В течение четырех месяцев был проведен эксперимент по влиянию дозированности рационов различных классов

(натуральный, промышленные рационы супер-премиум и эконом классов) на изменения упитанности, состояние метаболизма белков и жиров собак породы мопс. Полученные результаты важны для современной ветеринарной практики как элемент экспериментально доказательной науки, позволит вести эффективную просветительскую деятельность среди населения по профилактике ожирения у собак.

Ключевые слова: нерациональное кормление, упитанность, мопс, биохимические исследования, нарушение метаболизма.

Introduction

More than 740 million people live in 50 European countries, which are very heterogeneous in terms of size, geography, climate, economy, culture and diet. The prevalence of overweight and obese people and animals is over 60 % in many of these European countries [4, 7, 12]. Obesity and overweight are one of the most common pathological conditions among small domestic animals [2, 3]

Obesity of animals is polyethiological pathology. The main reason for its development is low physical activity, or the so-called "hypodynamia of animals". Under conditions of maintenance in the apartment, for the infrequent and short-lived "walk" small domestic animals do not spend enough energy received from the feed, which leads to excessive deposition of energy reserves in their body. Obesity and excessive body weight are one of the most common pathological conditions of small domestic animals. [3, 18] These conditions are associated with concomitant diseases such as orthopedic and endocrine disorders, as well as metabolic abnormalities [8, 13], renal dysfunction and breathing dysfunction. [13] In addition to these negative effects for the animal health, the quality of life is significantly worse in obese dogs and cats, and its duration can be significantly reduced [6, 11].

According to the literature data of special medical and veterinary sources, alimentary obesity most often is the result of excessive consumption of easily traceable feeds against the background of motility insufficiency. [5, 9] Under such conditions, the fats entering the body, as well as carbohydrates, are not completely

cleaved, but deposited in the subcutaneous tissue, accumulate around the internal organs (heart, kidneys, gonads, etc.), which in the future may lead to significant the diversity of concomitant pathology [13, 17].

Another cause of obesity is the effects of diseases associated with endocrine and central nervous system disorders [15]. According to the results of practitioners and scientists of humane medicine, now obesity is considered an epidemic of a non-infectious nature [7]. This opinion is also reflected among specialists in veterinary medicine, confirming the etiological factors of this disease [13].

Due to excess body weight in domestic dogs it is difficult to differentiate waist, spine and ribs, and a small layer of fatty tissue is palpated in the abdomen, back and thoracic cavity. The boundary between the chest and abdominal cavity is not determined. For obesity it is possible to visually estimate a significantly enlarged stomach, and the spine and edges are palpate almost imperceptible due to the thick fat layer. The back is bent, the limbs are short and thick, there are fatty folds that are not provided by the exterior of the breed. Minimal physical activity causes shortness of breath. During the walk, animals often lie down. Record changes on the part of the sexual system: reduction of sexual desire in dogs; irregular lambs, or lack thereof in females [7, 13].

Often over obesity, there may be problems with the hair, it becomes dull, screwed up, can form wipes. During the walk, animals often lie down. Changes of the sexual system are present: reduction of sexual desire in dogs; irregular lambs, or lack of females [4, 14].

Consequently, *purpose* of the work was to determine the effect of excessive and uncontrolled feeding on the development of excessive body weight of domestic dog of medium size, depending on the class and type of feeding diet.

Materials and methods

The research was conducted on the basis of the clinic of veterinary medicine at the Professor P. I. Lokes chair of therapy of the Poltava State Agrarian Academy during 2017. The object of the research was domestic dog breed pug (n=9) without

clinical manifestations of pathology, different sexes. Of these animals, three groups of 3 dogs in each were formed. They were fed one of the variants of the following diets:

- ration 1 – industrial super-premium class;
- ration 2 – industrial economy class;
- ration 3 – a natural diet.

The choice of breed pups was due to the fact that the representatives of this breed are much widespread and most favorable to the development of obesity. The selection of rations for dogs was carried out in accordance with the recommendations of veterinarian doctors, animal preference and financial capabilities of their owners.

This experiment was conducted in two stages. At the beginning of the study and at the end of each stage, morphometric measurements were monitored [8] and functional indicators of the body of animals were indicated:

Stage I – during the 2 months, the experimental animals were kept on selected rations, which clearly corresponded to the recommendations for doses and multiplicity of feeding.

Stage II – during the 3rd and 4th months, the experimental animals fed the same feed, but in an arbitrary number that was constantly in the feeders.

The importance of the first stage of research was due to the necessity to adhere to the purity of the experiment. Since before the dog was kept on various rations (often on mixed), this made it impossible to make a correct comparison of the results.

The registered animals that arrived at the clinic of veterinary medicine were examined according to the general scheme: anamnesis was collected, habitus, skin condition, visible mucous membranes, thermometry, weighing, morphometric measurements and calculations were performed, and the functional state of organs and systems was investigated [12, 14, 19]. After the 1st and 2nd stages of the experiment, repeated studies were conducted to monitor the condition of the dogs.

After, blood samples were taken from animals in each group for further laboratory studies. We have chosen and described the most informative blood parameters that characterize the state of exchange of lipids and proteins. Based on the

fact that almost 80 % of endogenous cholesterol is synthesized in the liver and intestines, and an excessive amount of exogenous cholesterol enters the body of dogs for unbalanced feeding, an important element in the study of the state of the liver and biliary pathways was the determination of the level of cholesterol, as well as its fractions. Amino acids that are absorbed from the intestine enter the liver, where, after deamination, they, depending on the needs, are converted into proteins, carbohydrates or lipids. Deamination is carried out by alpha-ketoacids metabolized for energy needs or used for the synthesis of monosaccharides and fatty acids. The protein exchange status was studied at the level of total protein and albumin in serum. Blood from domestic dogs was taken from the surface of the forearm's vein or from v. saphena (for biochemical studies). Biochemical studies were performed using the Vitros 250 automatic biochemical analyzer from the firm Orto-Clinical Diagnostics Ins. 100 Indigo Greek Drive Poshester New York 14626-5101, USA (Certificate of State Registration No. 4180/2005).

Statistical processing of the data was performed using the STATISTICA 7.0 (Stat Soft, USA) program with the mean arithmetic mean (M), the mean error (m), the confidence interval (CI) calculated by the formula $DI = M \pm m$ (for $p < 0.05$; $p < 0.01$; $p < 0.001$) [1].

Results of the study and their discussion

At the beginning of the experiment, morphometric measurements and calculations and weighing of experimental animals, were performed. The obtained results corresponded to the breeding standards for the selected breed of dogs. The functional state of the internal organs in these animals corresponded to the age and species of animals. Similar results were recorded in biochemical studies of serum, that is, in each dog, all the studied parameters did not go beyond the limits of physiological norms.

According to morphometric studies of domestic dog breed pug after the 1st stage of the experiment, there were no changes in the indices compared with the beginning of the experiment. It means that the dogs that have received rations

according to the regime and in normalized quantities. Steel remained the average body mass index, fattening of animals, and the amount of adipose tissue in the body.

At the end of the second stage of the experiment, a significant increase in the body weight of dogs for all rations was registered at 1.17, 1.22 and 1.14 times, respectively. Characteristic was the growth of the volume of the chest, some animals recorded a rounding of the body contours and slight smoothing of the waist. According to the owners, the animals became more lazy, walking was marked by a slight tendency to indifference to the games and faster fatigue.

The highest degree of fatness in dogs that got the ration 2, economy class, it was 3.3 ± 0.33 points. This have indicated the beginning of the development of nutritional obesity in dogs that were on the diet of the economy class in the conditions of constant access to the feeder.

Thus, after the second stage of the experiment, a tendency to accumulation of excessive body weight in animals in case of all rations was recorded. The worst indicators were recorded in dogs kept on the diet of the economy class.

The results of studies of protein metabolism in pups breed dogs after the first stage of the experiment have indicated that there were no significant changes compared to the beginning of the experiment, regardless of the composition of the diet (table 1). That is, the rations selected correspond to the needs of the dog's organism on the protein component, regardless of the grade of the feed.

As a result of excessive uncontrolled feeding (at the end of the second stage of the experiment), the presence of hyperproteinemia at dogs was recorded, which was manifested by an increase in the level of total protein in the serum of all 3 groups of animals at 1.13, 1.16 and 1.12 times, respectively.

1. Indecies of exchange of protein at dogs in experimental groups

Stage of experiment	Index		Ration 1	Ration 2	Ration 3
The start of experiment	Total protein, g/l	M \pm m	71.3 \pm 1.20	69.3 \pm 3.48	71.7 \pm 3.76
		CI	67.5-75.1	58.23-80.37	59.74-83.66
	Albumin, g/l	M \pm m	37.7 \pm 1.76	35.7 \pm 2.40	40.3 \pm 2.85
		CI	33.18-42.22	29.53-41.87	32.98-47.62

First stage of experiment	Total protein, g/l	M±m	74.3±0.88	70.7±1.45	74.0±1.53
		CI	71.50-77.10	66.07-75.27	69.13-78.87
	Albumin, g/l	M±m	41.3±0.88	35.3±1.45	43.3±0.88
		CI	39.04-43.56	31.57-39.03	41.04-45.56
Second stage of experiment	Total protein, g/l	M±m	83.7±1.45*	82.0±2.08*	83.0±1.15*
		CI	79.07-88.27	75.40-88.6	79.34-86.66
	Albumin, g/l	M±m	47.3±0.88*	45.3±1.45*	49.3±0.88*
		CI	45.04-49.56	41.57-49.03	47.04-51.56

Note: CI is a confidence interval for * $p \leq 0.05$, ** $p \leq 0.01$; *** $p \leq 0.001$ compared to the results after the first stage of the experiment

Analysis of proteinograms has showed that the increase in the total protein in the blood serum was due to an increase of the albumin fraction of protein at 1.15, 1.28 and 1.14 times, respectively.

Changes in protein metabolism may indicate the liver damage, because most proteins are synthesized in hepatocytes. Such changes may also be the result of a change in feed, because dogs were kept in other rations until the experiment.

Analyzing the composition of the lipidograms (table 2), we have found that in blood serum of dogs that have got a ration 1 of supra-premium class within 2 months according to the recommendations of the manufacturer, there were no significant changes in the content of triglycerols, total cholesterol and lipoproteins of all fractions. Since after the 1st stage of the experiment, the clinical condition and morphometric indices of the animals of this group did not change, it can be considered that the above mentioned diet (in case of following the multiplicity and dosage of feeding) had no negative impact on the general health of animals, as evidenced by the level of indicators exchange of proteins and lipids.

Subsequently, during the second stage of the experiment, the dogs were kept in the same ration, but the feed was kept in feeders constantly. Such a violation of the feeding regime did not affect the general clinical condition of animals, but led to an increase in their body mass in 1.17 times, hyperproteinemia and lipid metabolism disorders. In blood serum of animals a significant increase in 1.32 times the

concentration of triglycerols and 1.32 times – LVLD were noted, compared with these indicators after the 1st stage of the experiment.

2. Indecies of exchange of lipid at dogs in experimental groups

Stage of experiment	Index		Ration 1	Ration 2	Ration 3
The start of experiment	Triglycerols, mmol/l	M±m	1.00±0.076	0.96±0.055	0.94±0.107
		CI	0.760-1.240	0.790-1.130	0.600-1.280
	Cholesterol general, mmol/l	M±m	3.07±0.152	3.41±0.227	3.32±0.177
		CI	2.59-3.59	2.69-4.13	2.76-3.88
	LHD (lipoproteins of high density), mmol/l	M±m	1.77±0.088	1.90±0.109	1.81±0.068
		CI	1.49-2.05	1.55-2.25	1.59-2.03
	LLD (lipoproteins of low density), mmol/l	M±m	0.84±0.062	1.07±0.012	1.07±0.085
		CI	0.64-1.04	1.03-1.11	0.80-1.34
First stage of experiment	Triglycerols, mmol/l	M±m	0.46±0.035	0.44±0.025	0.43±0.049
		CI	0.35-0.57	0.36-0.52	0.27-0.59
	Triglycerols, mmol/l	M±m	1.11±0.075	1.33±0.055*	1.07±0.055
		CI	0.870-1.330	1.150-1.490	0.900-1.240
	Cholesterol general, mmol/l	M±m	3.41±0.101	3.73±0.169	3.57±0.136
		CI	3.09-3.73	3.19-4.27	3.14-4.00
	LHD (lipoproteins of high density), mmol/l	M±m	1.97±0.078	1.94±0.071	1.93±0.052
		CI	1.72-2.22	1.71-2.17	1.76-2.10
Second stage of experiment	LLD (lipoproteins of low density), mmol/l	M±m	0.94±0.054	1.18±0.122	1.14±0.088
		CI	0.77-1.11	0.79-1.57	0.86-1.42
	LVLD (lipoproteins of very low density), mmol/l	M±m	0.51±0.035	0.61±0.025*	0.49±0.034
		CI	0.40-0.61	0.53-0.69	0.40-0.58
	Triglycerols, mmol/l	M±m	1.46±0.040*	1.59±0.026*	1.40±0.045*
		CI	1.330-1.590	1.510-1.670	1.285-1.515
	Cholesterol general, mmol/l	M±m	4.05±0.109	4.69±0.052*	4.39±0.126*
		CI	3.70-4.40	4.52-4.86	4.00-4.80
	LHD (lipoproteins of high density), mmol/l	M±m	2.37±0.133	2.11±0.032	2.38±0.041*
		CI	1.95-2.79	2.01-2.21	2.25-2.51
	LLD (lipoproteins of low density), mmol/l	M±m	1.01±0.047	1.85±0.044*	1.37±0.094
		CI	0.86-1.16	1.71-1.99	1.07-1.67
	LVLD (lipoproteins of very low density), mmol/l	M±m	0.67±0.018*	0.73±0.012*	0.64±0.020*
		CI	0.61-0.73	0.69-0.73	0.59-0.69

Note: CI is a confidence interval for * $p \leq 0.05$, ** $p \leq 0.01$; *** $p \leq 0.001$ compared to the results after the first stage of the experiment

After the second stage of the experiment (in case of using of a free-class diet for a free class) on the background of hyperproteinemia and increase in body weight of dogs in 1.22 times, the state of lipid metabolism deteriorated to a greater extent, compared with the indices after the I-th stage. In the blood serum of dogs, the concentration of triglycerols and LVLD in 1.31 times, total cholesterol and LLD in the 1.2 and 1.57 times has increased, respectively. Important was the lack of significant changes in the level of LHD in blood serum of dogs, which was a negative indicator of lipid metabolism, since it indicated a lack of compensatory enhancement of the reverse pathway of cholesterol from tissues and vessel walls in the liver.

Consequently, in blood serum of dogs of the pug breed in case of the using of feed of the economy class (ration 2), the concentration of total cholesterol (due to fractions of LLD, LVLD) and triglycerols has increased, which reduced to increased fat formation, deposition in fat stores, organs and tissues. In the future, this leads to the development of obesity, hepatolipidosis, and others.

In dogs that were kept in ration 3 (natural), at the end of the 1st stage of the experiment, no negative changes were observed in the morphometric parameters, as well as in the metabolism of proteins and lipids, as well as in ration 1.

At the end of the second stage of the experiment, as morphometric (body mass increase in 1.14 times), the biochemical parameters of the dogs also have undergone certain changes: the protein content of the blood serum has increased; the level of triglycerides, total cholesterol and LHD has increased in 1.31, 1.23 and 1.23 times, respectively. We believe that this dynamics was more positive than for ration 2 (economy class), because for the use of natural feeds, there was an compensatory increase in the content of LHD, that has indicated the adaptive processes in the organism of dogs, aimed at reducing hypercholesterolemia.

Consequently, the results of our research suggest that the rationing of feeding domestic cats and dogs, regardless of whether this food is industrial production, or

food "from the table". Prolonged maintenance of animals, even in excess of super-premium feed, can lead to the development of metabolic disorders in the dog's body and lead to the development of excess body weight, and in the future – obesity.

The biggest violations of status were registered in case of using of the industrial fodder of the economy class for feeding dogs, even if the owners of the animals comply with the manufacturer's recommendations regarding the number and multiplicity of feeding. The resulting changes in proteinuria and lipid metabolism showed that in the future, without changing the diet, it can contribute to the development of liver disease and metabolic disorders in general.

An important prognostic criterion for lipid metabolism is the increase of cholesterol, LHD, LLD and LVLD. According to various authors, changes in lipid and lipoprotein contents in dog's blood serum at obesity have a different orientation [6]. Thus, the content of total cholesterol increases at the expense of so-called "atherogenic lipoproteins", and the level of cholesterol and LHD have only a tendency for its growth, but there is no observed decrease in the level of this fraction [9]. In other literary sources, on the contrary, the significant increase of the concentration of LLD cholesterol is noted. Also, the level of LVLD differs, according to some authors, it increased at obesity. Significant differences in the results of the research are likely to be due to significant differences in the composition of the research groups and methods for calculating the proportion of LVLD in the composition of TG. The common feature of the studies is the increase of the level of cholesterol LHD in different degrees. Principal definition of the latter is due to the genetic feature of small animals compared with humans. So, in dogs the content of LHD in serum is much lower. This is an indicator of human predisposition for developing atherosclerosis, unlike dogs, in which this pathology is rarely associated with obesity [15, 20]. For obesity, the diagnostic informative of TG and LVLD (main storages and carriers of lipids in the body) was only 20 %, total cholesterol – 50 %, LLD – 90 %, LHD – 30 %. The indices of LHD did not decrease, but rose at the upper limit of the control group. The rest of the dogs (70 %) did not change their level unlike other internal diseases when there was a significant decrease. It is an

indicator of a "reverse circle" violation that ensures the excess of cholesterol from tissues in the liver, where it is converted into bile acids, steroids and vitamin D3. Consequently, according to many researchers, obesity does not significantly disrupt this process, and 30 % of dogs are even activated [10].

An important result of reducing body weight for obesity in small animals is the improvement of the life quality. Detected mixed results in terms of the effect of body weight loss on animal activity. Some authors argue that the activity of obese dogs is lower than that of dogs with perfect fecundity [6], but no improvement in activity in rats that lost weight [9, 16]. Since dog pugs breed are prone to lazy lifestyles, our studies have confirmed drowsiness after the end of the second stage of the experiment, when animals consumed food uncontrolledly. Even playful dogs became more lazy and less active were subjected to the game with the masters.

Thus, the diagnostic information of lipid and metabolic rates makes it possible to use them to diagnose the risk of obesity for middle-breed dogs.

Conclusion

The effect of abnormal excessive feeding on the development of excess body weight in dogs of medium breed, namely pug was experimentally proved. This breed is very common in Ukraine and is prone to the development of nutritional obesity. The compensatory mechanism of lipid exchange for excessive consumption of animal feed was studied. The worst indicators of exchange of lipids and proteins for feeding an industrial-grade diet of the economy class, even at normalized feeding, were established. Such metabolic changes in the future can lead to the development of obesity and other concomitant internal pathology. The obtained results are important for modern veterinary practice as an element of experimental and evidentiary science, which will allow conducting effective educational activities among the population on the prevention of obesity in dogs.

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