# PROSPECTS OF USE OF NUTRIENT FIBER, APPLYING DIFFERENT FEEDING MANNERS, TO REDUCE OBESITY IN DOGS

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**Abstract.** Obesity is the most prevalent nutritional disorder encountered in company animals. Problems related with obesity are the higher incidence of pathological morbidity and mortality of dogs. The dog, having 15% or more overweight clinically is called obese. Nowadays 25–40% of dogs around the world carries overweight or obese. Nutritional and physical activity interventions have been common strategies. More attention has been given to the nutrient and energy composition of diets. Strategies to maximize dog health such as 'lite' and therapeutic diets have been available for years; the rates of obesity are increasing in companion animals day by day (Heuberger, Wakshlag, 2011).

The aim of this study is to define the effect of diet containing nutrient fiber on the assimilation of nutrients, healthiness and weight reduction in small breed of dogs. Three analogical groups were selected for the experiment. Dogs in I group were fed once per day with free access to food in the morning, II group – twice per day: in the morning and in the evening with free access to food; III group – twice per day: in the morning and in the evening with restricted time of feeding.

Moister content in feces in dogs fed in the morning and in the evening with restricted time of feeding was the lowest – 60,06 per cent or 2,35 per cent less in comparison with faeces of dogs fed once per day ($p<0.001$). Feeding twice per day with restricted time of feeding or with free access to food had a positive impact in assimilation of nutrients: crude protein ($p<0.001$), crude fat ($p<0.001$), crude fiber ($p<0.001$) were absorbed better in comparison with absorption in dogs fed once per day.

Weight loss in 180 days trial period in dogs fed once per day was 1210 g, in dogs fed twice per day with free access to food – 1270 g, in dogs with restricted feeding time – 1570 g. Chest and waist measurements in all periods of trial were smaller in the groups where dogs were fed twice per day with restricted time of feeding or with free access to food.

**Keywords:** dog, diet, nutrient fiber, digestibility, obesity

**Introduction.** In some countries, approximately, 68 % of adult humans are obese (Hedley et al., 2004). It is estimated that 55 % of dogs and 53 % of cats are overweight or obese (Calabash, 2013). Obesity has become the leading health treat in pets and the major cause of death (Ward, 2014) and the most prevalent nutritional disorder in small animal practice (Jeusette et al., 2005). Obesity represents a major public health problem (Anandacoomarasamy et al., 2012).

Measurement of health-related quality of life (HRQOL), is now a key tool in outcome assessment for human medicine, and is being increasingly adopted in veterinary. Recently, a tool for measuring canine HRQOL has been developed for use by owners, since they are best placed to identify the subtle behavioural changes of early chronic illness. This tool has previously been validated and has good discriminatory properties for dogs with chronic pain from degenerative joint disease (Wiseman-Orr et al., 2006). However, it has not yet been used to determine the quality of life in other conditions including obesity (German et al., 2012).

To control and prevent obesity, nutritional and physical activity has been common factors employed (Rossmeisl et al., 2009). There are several obesity controlling systems available for pets, such as physical activity, special diet etc. Quite often we meet obesity as a secondary disorder, so in this case we must decide, which disorder we try to fix first or if we can work on both diseases at a time. Obesity is defined as excess body fat accumulation that may impair health. In recent years, attention to weight bias has increased, with a growing recognition of the pervasiveness of weight bias and stigma, and its potential harmful consequences for obese persons (Rebecca, Chelsea, Heuer, 2009).

Knowledge of obesity/overweight as a risk factor for disease can heighten awareness and target health screening of dogs. With evidence from canine research studies as a tool, practitioners may be able to advocate more strongly for obesity prevention and weight reduction plans for their clients' pets (Lund et al., 2006).

Obesity in the companion animal population has also skyrocketed and it has been considered the most common nutritional disorder in pets (German, 2006). Dogs are considered overweight when their body weight exceeds 15 % of their ideal body weight and obese when their body weight surpasses 30 % of normal (Burkholder, Toll, 2000). Control of obesity has been: dietary management, energy restriction, and increased physical activity. Therefore, alternative strategies in the dietary management of obesity have included considerations about the nutrient composition and value of diets, use of supplements as a mean to aid in weight loss, avoid weight gain.

Traditionally in companion animal nutrition the most popular ingredient used as a source of carbohydrates is beet pulp.. Carbohydrate fractions, also named dietary

fibers, will enter the large intestine where they have the potential to be fermented by the hindgut microbiota. Common fermentable carbohydrate is hemicelluloses (NRC, 2006). Dietary fibers play an important role in gut health and in the management of some pathological conditions. Fermentable and soluble fibers increase digest viscosity, increase satiety, reduce the rate of glucose uptake, lower blood cholesterol levels, promote growth of gut commensal bacteria (Brennan, Cleary, 2005; Jenkins et al., 2008).

The aim of this study is to define the effect of diet on the assimilation of nutrients, loss of body weight and healthiness of dogs using different feeding manners: once or twice per day with free access to the food and twice per day with restricted feeding time.

**Material and methods.** Animals, diet, and treatments: the experiment was carried out in dog breeding centers and in the laboratory of Forage investigation in the Department of Animal nutrition of Lithuanian University of Health Sciences in 2013. Dogs of breed Yorkshire terrier were selected for the experiment, taking into consideration their weight, clinical status, age, and physiological condition. The study included seven dogs in each group, obese female dogs that weighed 6.0–6.5 kg and at the time of research were 5.0– 6.5 years old. Dogs were kept in specially adapted spaces and isolated from other animals. The duration of experiment was 180 days. Dogs were divided in to three groups – 7 dogs in each group. Dogs in group I were fed once per day with free access to food (could eat till they finished), in group II – twice per day: in the morning and in the evening with free access to food (could eat as long as they wanted, till they finished); in group III – twice per day with restricted time of feeding.

During the experiment, attention was paid to the way dogs were fed, not to the food itself, knowing that chosen food for a trial was well known „PRO PLAN Adult small & mini", which had: chicken (20 per cent.), rice (15 per cent.), dried poultry protein, corn gluten meal, corn, wheat, animal fat, animal digest, dried beet pulp, dried egg product, fish oil, yeast, calcium phosphate, potassium chloride, sodium chloride, calcium carbonate, minerals. Nutritional and energy value of the diet (per cent): dry matter – 92.0, crude protein – 29.0, crude fat – 18.0, crude fiber – 2.0, crude ash – 7.0, metabolizable energy – 20.8 MJ kg-1. There is in 1 kg: 21000 IU vit. A, 1600 IU vit. D3, 170 mg vit. E, 70 mg vit. C, 200 mg vit. B1.

Sample analysis: diet (sample taken before use), the feces of dogs were collected into sterile disposable cups daily in the evening and delivered to the laboratory. Analysis of feces and diet was carried out according to generally accepted methods. Dry matter by deducting the general moisture, crude protein was determined by Kjeldahl method, crude fat according to its solubility in organic solvents, crude fibre by Kiurshner method, and crude ash by burning dry process. The energy value was calculated according to nutrients calorie content. The coefficients of nutrient digestibility were calculated (Januškevičius, Januškevičienė, 2010). Amount of diet fed and amount of feces was weighted using scales KERN EW600 2M, dogs where weighted using household scales.

Dog's venous blood was taken from vena cephalica using vacuum blood collection system with 4 cc vacuum test-tubes with additives. Blood samples for complete blood count and biochemistry analysis were immediately taken to laboratory. Complete blood count analyzed using Mythic 18 Vet (Orphee, Switzerland) analyzer, with Vet-M-Pack reagent kit and EDTA K3 test-tubes. Blood biochemistry analyzed using VetTest (Idexx, USA) analyzer, blood plasma obtained by centrifuging samples with StatSpin centrifuge and using General Health Profile reagent kit.

Statistical results – arithmetic mean, error of the arithmetic mean, criteria and degree of reliability, were defined according to Stjudent; a statistical package was used (Sakalauskas, 1998).

The research was conducted in accordance with Law on Welfare and Protection of Animals (Official Gazette. 1997, no. 108-2728, no. 122-6126) of the Republic of Lithuania with European Parliament and Council Directive 2010/63/EU for protection of animals used for scientific purposes (OJ 2010 L 276, p. 33) (2010, September 22), with the European Convention for protection of vertebrate animals used for experimental and other scientific purposes (Official Gazette., 2007, no. 49-1883, no. 49-1884), and the State Food and Veterinary Service Director's Order "For approval of holding and handling requirements of animals used for education and training purposes" 2012. 31 October. No. B1-866 (Official Gazette. 2012, no. 130-6595).

**Results.** The research was performed with overweight adult Yorkshire terrier breed dogs. All dogs were fed the same diet. 100 g of diet 2.0 g dietary fiber, the chosen source was dried beet pulp. All dogs were fed the same quantity of diet, only the feeding manner was different: feeding with free access to food, feeding times per day differed and the time given for food intake differed. Feeding was carried out accurately determining quantities of food and quantities of faeces excreted.

The quantities of excreted faeces were determined by digestibility tests run in the beginning, in the middle and at the end of the experiment. Differences between nutrient content in faeces among the groups in the beginning and in the middle of experiment varied sligthly. In the beginning of the trial, the biggest quantity of dry matter in faeces was found in the group fed once per day – in the morning: 39.41 per cent, or 1.43 1.59 per cent more compared with faeces from groups II and III ($p<0.01$). A more pronounced difference between nitrogen free extractives found in dog faeces was observed – in the dogs from group I 25.07 per cent, or by 1.82 per cent more compared to group II ($p<0.001$) and by 1.66 per cent more compared to group III($p<0.001$). In the middle of the experiment, the biggest quantity of dry matter in dog faeces was found in the group of dogs fed in the morning and in the evening with restricted time of feeding – 39.88 per cent (38.89 per cent in group I and 39.52 per cent in group II).

Table 1. **Nutritional and energy value of faeces** (beginning, middle and end of the trial)

| Nutrient, per cent | **Begining of trial** | | |
|---|---|---|---|
| | I n=7 | II n=7 | III n=7 |
| Moisture | 61,29±0,16 | 62,02±0,17** | 62,18±0,21** |
| Dry matter | 39,41±0,31 | 37,98±0,26** | 37,82±0,25** |
| Organic material | 33,67±0,11 | 31,94±0,08*** | 32,00±0,08*** |
| Crude protein | 5,12±0,08 | 5,01±0,10 | 5,11±0,12 |
| Crude fat | 1,16±0,04 | 1,32±0,06* | 1,26±0,07 |
| Crude fiber | 2,32±0,12 | 2,36±0,12 | 2,22±0,11 |
| Crude ash | 5,74±0,15 | 6,00±0,13 | 5,82±0,08 |
| Nitrogen free extractives | 25,07±0,16 | 23,25±0,24*** | 23,41±0,22*** |
| Metabolizable energy, MJ $kg^{-1}$ | 6,54 | 6,27 | 6,27 |
| Nutrient, per cent. | **Middle of trial** | | |
| | I n=7 | II n=7 | III n=7 |
| Moisture | 61,11±0,12 | 60,48±0,11** | 60,12±0,14*** |
| Dry matter | 38,89±0,22 | 39,52±0,06* | 39,88±0,10** |
| Organic material | 32,57±0,21 | 33,44±0,18** | 33,88±0,28** |
| Crude protein | 4,94±0,18 | 5,00±0,22 | 4,96±0,66 |
| Crude fat | 1,66±0,10 | 1,72±0,12 | 1,60±0,08 |
| Crude fiber | 4,23±0,28 | 4,36±0,20 | 4,02±0,16 |
| Crude ash | 6,32±0,12 | 6,08±0,10 | 6,00±0,12 |
| Nitrogen free extractives | 21,74±0,18 | 22,36±0,22* | 23,30±0,24*** |
| Metabolizable energy, MJ $kg^{-1}$ | 6,50 | 6,67 | 6,71 |
| Nutrient, per cent. | **End of trial** | | |
| | I n=7 | II n=7 | III n=7 |
| Moisture | 62.41±0.19 | 61.24±0,20*** | 60.06±0.17*** |
| Dry matter | 37.69±0.24 | 38.76±0.11** | 39.12±0.11*** |
| Organic material | 32.21±0.14 | 33.34±0.24** | 33.86±0.12*** |
| Crude protein | 4.04±0.12 | 4.00±0.10 | 4.84±0.14*** |
| Crude fat | 2.44±0.14 | 2.22±0.11 | 2.61±0.13 |
| Crude fiber | 5.46±0.18 | 4.36±0.18*** | 5.02±0.16 |
| Crude ash | 5.48±0.10 | 5.42±0.08 | 5.26±0.08 |
| Nitrogen free extractives | 20.27±0.2 | 22.76±0.34** | 21.39±0.16** |
| Metabolizable energy, MJ $kg^{-1}$ | 6.57 | 6.70 | 6.95 |
| p*<0.05; **p<0.01; ***p<0.001 | | | |

At the end of the experiment, more moisture was found in dog faeces of group I – 62.41 per cent, or by 2.35 per cent more compared to moisture content in dog faeces of group III (p<0.001). Rationed food intake had a positive influence to the crude protein content – 4.84 g kg-1 was found, in group III or by 0.8 g more compared to crude protein content found in group I (p<0.001) (Table 1).

Accurate measurements of quantities of food and quantities of faeces excreted were determined by digestibility tests run in the beginning, in the middle and at the end of the scientific research. At the same time nutrient absorption rates were found. (Tables 2, 3 and 4).

Table 2. **Nutrient absorption rate at the beginning of experiment**

| Nutrient, per cent. | Group | | |
|---|---|---|---|
| | I n=7 | II n=7 | III n=7 |
| Dry matter | 70.1±0.27 | 70.7±0.18 | 70.7±0.23 |
| Organic material | 72.7±0.21 | 73.7±0.14** | 73.5±0.20* |
| Crude protein | 86.4±0.26 | 86.4±0.28 | 86.8±0.25 |
| Crude fat | 90.4±0.13 | 91.4±0.09*** | 91.9±0.04*** |
| Crude fiber | 87.0±0.10 | 87.3±0.12 | 88.1±0.11*** |
| Crude ash | 33.3±0.27 | 28.7±0.25*** | 30.5±0.19*** |
| Nitrogen free extractives | 51.2±0.16 | 54.0±0.12*** | 53.5±0.21*** |
| *p<0.05; **p<0.01; ***p<0.001 | | | |

In the beginning of the experiment, feeding the dogs once per day, the rate of crude fat absorption was 90.4 per cent., feeding twice per day, in both groups crude fat was absorbed better – in group II by 1.0 per cent ($p<0.001$), in group III by 1.5 per cent better ($p<0.001$) compared to the result of group I. Crude fiber was absorbed best in dogs fed with restricted time of feeding – 88.1 per cent, or by 1.1 per cent better compared to absorption of crude fiber in group I ($p<0,001$). Crude ash absorption rate in dogs from group I was 33.3 per cent, in groups II and III absorption rate of crude ash was lower: 4.6 and 2.8 per cent ($p<0.001$).

Better nutrient absorption was observed after three months from the beginning of the experiment in the groups were diet was fed twice per day. Dry matter in group I was absorbed to 70.2 per cent, or by 1.5–1.7 per cent ($p<0.001$), crude fiber by 0.9–3.0 per cent ($p<0.001$), crude ash by 6.5–8.3 per cent ($p<0.001$) less compared to the results in groups II and III.

Table 3. **Nutrient absorption rate in the middle of experiment**

| Nutrient, per cent. | Group | | |
|---|---|---|---|
| | I n=7 | II n=7 | III n=7 |
| Dry matter | 70.2±0.24 | 71.5±0.08*** | 71.7±0.16*** |
| Organic material | 73.4±0.13 | 74.2±0.25* | 74.2±0.15** |
| Crude protein | 86.6±0.08 | 87.2±0.11*** | 87.7±0.07*** |
| Crude fat | 89.0±0.12 | 89.9±0.10*** | 90.4±0.09*** |
| Crude fiber | 77.1±0.20 | 78.0±0.17** | 80.1±0.24*** |
| Crude ash | 25.9±0.32 | 32.4±0.26*** | 34.2±0.18*** |
| Nitrogen free extractives | 57.4±0.14 | 58.6±0.20*** | 57.5±0.30 |
| *p<0.05; **p<0.01;***p<0.001 | | | |

Nutrient absorption after six months from the beginning of experiment in the dog group fed all daily intakes only in the morning was in all cases in lower levels. Crude protein in group I was absorbed to 87.6 per cent, whereas in group II proteins were absorbed to 90.0 per cent, or by 2.4 per cent better ($p<0.001$), in group III 88.3 per cent, and by 0.7 per cent better ($p<0.001$). Significantly higher crude fiber absorption rate was noted: in group I fiber was absorbed to 71.6 per cent or by 6.8 per cent ($p<0.001$) better than in group II and by 4.2 per cent ($p<0.001$) better than in group III.

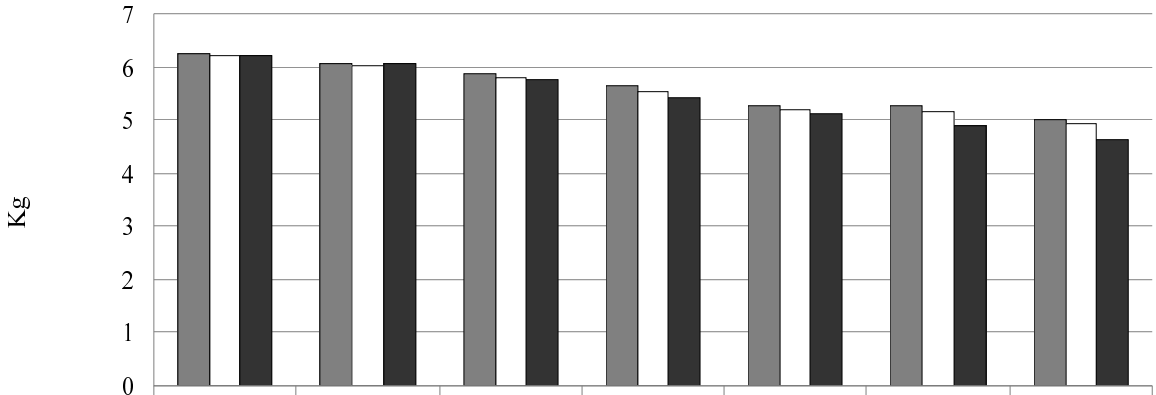
Table 4. **Nutrient absorption rate at the end of experiment**

| Nutrient, per cent. | Group | | |
|---|---|---|---|
| | I n=7 | II n=7 | III n=7 |
| Dry matter | 72.3±0.30 | 72.5±0.24 | 73.1±0.22* |
| Organic material | 73.7±0.20 | 74.5±0.18* | 75.1±0.24*** |
| Crude protein | 87.6±0.12 | 90.0±0.11*** | 88.3±0.11*** |
| Crude fat | 83.8±0.08 | 86.9±0.10*** | 84.8±0.06*** |
| Crude fiber | 71.6±0.18 | 78.4±0.20*** | 75.8±0.18*** |
| Crude ash | 37.9±0.28 | 40.7±0.16*** | 44.4±0.11*** |
| Nitrogen free extractives | 57.2±0.26 | 58.5±0.32** | 62.3±0.27*** |
| *p<0.05; **p<0.01; ***p<0.001 | | | |

Dogs selected for the experiment weighed 6.20–6.23 kg. The changes in dog's weight were documented every 30 days. During the whole period of the experiment, dogs in group I lost 1.21 kg of their body weight, in group II 1.27 kg, or by 4.96 per cent more and in group III 1.57 kg or by 29.75 per cent more (Fig. 1).

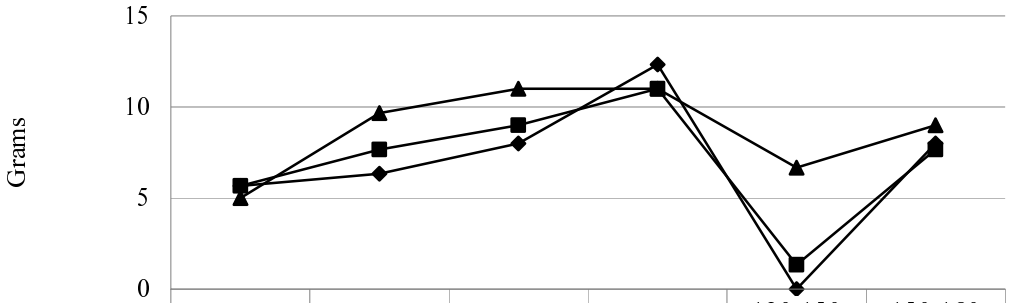
During the first 30 days, weight loss per day was 5.00–5.67 g. Weight loss in group of dogs during the second month was 6.33 g, in group 7.67 g, or by 17.47 per cent more, in group III by 34.54 per cent more ($p<0.001$). Weight loss per day increased in all groups during the third period: in group I weight loss per day was 8.00 g, in groups II and III by 1.00–3.00 g higher respectively.

Significant weight loss was observed during 90–120 days period. Dogs fed once per day lost 12.33 g per day, or by 12.09 per cent more compared with dogs fed twice per day with free access to food or with restricted feeding time. During the second period, after intensive weight loss during the first period in group I dogs passed unchanged weight: 5.26 kg. During this period, the major influence to overweight was feeding manner – in the morning and in the evening with restricted feeding time. It was observed that weight loss trend remained among all groups of dogs from 120 days up to the end of the experiment. During the half year period of experiment the weight loss per day in group I was 6.72 g, in group II 7.05 g, or by 4.68 per cent higher, in group III 8.72 g, or by 23.81 per cent higher ($p<0.01$).




| | 0 Days | 30 Days | 60 Days | 90 Days | 120 days | 150 Days | 180 Days |
|---|---|---|---|---|---|---|---|
| 1st group | 6,23 | 6,06 | 5,87 | 5,63 | 5,26 | 5,26 | 5,02 |
| 2nd group | 6,2 | 6,03 | 5,8 | 5,53 | 5,2 | 5,16 | 4,93 |
| 3rd group | 6,2 | 6,05 | 5,76 | 5,43 | 5,1 | 4,9 | 4,63 |

Fig. 1. **Dog weight changes during different periods of the experiment**




| | 0-30 days | 30-60 days | 60-90 days | 90-120 days | 120-150 days | 150-180 days |
|---|---|---|---|---|---|---|
| Group 1 | 5,67 | 6,33 | 8 | 12,33 | 0 | 8 |
| Group 2 | 5,67 | 7,67 | 9 | 11 | 1,33 | 7,67 |
| Group 3 | 5 | 9,67 | 11 | 11 | 6,67 | 9 |

Fig. 2. **Weight loss per day (g)**

Chest and waist measurements in dogs were taken during the experiment. Chest and waist measurement data was documented at the beginning of experiment, after 1, 2, 3, 4, 5 and 6 months. It was observed, that with decreasing weight dogs' chest girth also decreased. At the beginning dogs' chest girth was 46.2–46.4 cm. After three months, chest girth in group I decreased by 2.65 per cent, II by 0.02 per cent and III by 0.92 per cent more ($p<0.01$). After half year of observation, the smallest chest girth was noted in dogs fed twice per day with restricted feeding time – 41.0 cm, or by 3.41 per cent smaller compared with the chest girth in dogs fed once per day (Table 5).

Waist girth measurement decreased only slightly during the first three months and nearly the same measure in all dogs. After 4 months trial period, waist girth in group III was 36.0 cm or by 1.0 cm smaller compared to dogs waist girth in other other groups ($p<0.001$). The most significant waist girth decrease was observed in group III during the period of the last month 34.0 cm, or by 5.03 per cent smaller compared to group I ($p<0.001$) and by 3.96 per cent smaller compared to group II (Table 5).

During the weight loss process, dogs' health status was tested: biochemical and morphological characteristics of blood were determined (Table 6).

The blood was tested twice during the experiment: in the beginning and at the end of the trial. The analysis of blood taken in the beginning of the experiment showed that morphological and biochemical parameters were within normal limits. The observed obesity did not show any signs of disease.

Table 5. **Chest and waist measurements in dogs** (cm)

| Period | Group | | |
|---|---|---|---|
| | I n=7 | II n=7 | III n=7 |
| Chest | | | |
| Beginning of experiment | 46.4±0.18 | 46.2±0.16 | 46.4±0.12 |
| after 1 month | 46.0±0.20 | 45.8±0.14 | 45.7±0.16 |
| after 2 months | 45.6±0.16 | 45.2±0.12 | 45.0±0.11** |
| after 3 months | 45.2±0.12 | 45.0±0.10 | 44.8±0.06** |
| after 4 months | 44.6±0.10 | 44.4±0.11 | 44.2±0.12* |
| after 5 months | 44.0±0.14 | 43.6±0.08* | 43.0±0.10** |
| after 6 months | 42.4±0.08 | 42.0±0.10 | 41.0±0.08*** |
| Waist | | | |
| Beginning of experiment | 39.6±0.28 | 39.4±0.24 | 39.6±0.24 |
| after 1 month | 39.4±0.20 | 39.2±0.16 | 39.0±0.16 |
| after 2 months | 38.6±0.22 | 38.2±0.20* | 38.0±0.18* |
| after 3 months | 37.2±0.12 | 37.0±0.14 | 36.8±0.08* |
| after 4 months | 37.0±0.18 | 37.0±0.24 | 36.0±0.06*** |
| after 5 months | 36.1±0.12 | 36.0±0.08 | 35.4±0.10** |
| after 6 months | 35.8±0.11 | 35.4±0.10 | 34.0±0.11*** |
| *p<0,05; **p<0,01; ***p<0,001 | | | |

Table 6. **Biochemical and morphological characteristics of blood in dogs**

| Parameter | Group | | |
|---|---|---|---|
| | I n=7 | II n=7 | III n=7 |
| Biochemical parameters of blood | | | |
| Total protein, g $L^{-1}$ | 64.54±0.20 | 64.86±0.08 | 65.12±0.11* |
| Bilirubin, µmol $L^{-1}$ | 1.10±0.08 | 1.14±0.06 | 1.20±0.08 |
| Creatinine, µmol $L^{-1}$ | 47.62±0.10 | 47.66±0.12 | 47.99±0.11* |
| Urea, mmol $L^{-1}$ | 7.32±0.06 | 7.07±0.10* | 7.00±0.10* |
| Alkaline phosphatase, IU $L^{-1}$ | 44.11±0.14 | 44.02±0.20 | 44.27±0.06 |
| Aspartate aminotransferase, IU $L^{-1}$ | 15.28±0.06 | 15.86±0.08*** | 15.98±0.10*** |
| Alanine aminotransferase, IU $L^{-1}$ | 27.21±0.08 | 27.30±0.10 | 27.64±0.11** |
| Calcium, mmol $L^{-1}$ | 2.66±0.04 | 2.64±0.02 | 2.70±0.03 |
| Phosphorus, mmol $L^{-1}$ | 1.30±0.06 | 1.32±0.10 | 1.40±0.01 |
| Potassium, mmol $L^{-1}$ | 3.92±0.03 | 4.04±0.01*** | 4.08±0.01*** |
| Sodium, mmol $L^{-1}$ | 150.24±0.18 | 151.82±0.20*** | 152.06±0.16*** |
| Morphological parameters of blood | | | |
| Erythrocytes, $10^{12}$ $L^{-1}$ | 6.70±0.14 | 7.32±0.08** | 7.48±0.11*** |
| Leucocytes, $10^{9}$ $L^{-1}$ | 7.86±0.18 | 7.62±0.11 | 7.38±0.10* |
| Lymphocytes, per cent | 22.41±0.14 | 22.05±0.08* | 21.98±0.20* |
| Monocytes, per cent | 5.34±0.14 | 5.12±0.04* | 4.76±0.04** |
| Granulocytes, per cent | 72.25±0.11 | 72.83±0.08** | 73.26±0.20*** |
| Hemoglobin, g $L^{-1}$ | 162.03±0.18 | 164.68±0.24*** | 168.24±0.48*** |
| Hematocrit, per cent | 44.38±0.26 | 42.52±0.30*** | 42.08±0.20*** |
| Mean corpuscular hemoglobin concentration, g $L^{-1}$ | 334.22±0.56 | 338.92±0.24*** | 340.60±0.21*** |
| Thrombocytes, $10^{9}$ $L^{-1}$ | 210.32±0.34 | 206.02±0.42*** | 206.21±0.31*** |
| *p<0.05; **p<0.01; ***p<0.001 | | | |

In group III blood samples of dogs at the end of the experiment showed a significant increase in total protein – 65.12 g $L^{-1}$ or by 0.88 per cent higher ($p<0.05$) compared to group I. In comparison with the beginning of the experiment it did not change a lot. At the beginning of the trial, in group I it was 64.41 g $L^{-1}$, in group II 64.87 g $L^{-1}$ and in group III 65.08 g $L^{-1}$. A slight rise in bilirubin (normality 0–15 µmol $L^{-1}$), creatinine values was observed (normality 44–159 µmol $L^{-1}$); urea value in the blood from group I was 7.32 mmol $L^{-1}$, or by 4.57 per cent higher compared to urea value in group III ($p<0.05$) at the end of the trial. In group I, blood enzyme aspartate

aminotransferase value was 15.28 IU $L^{-1}$, or by.66–4.58 per cent lower compared to groups II and III ($p<0.001$), (normality 0–50 IU $L^{-1)}$). At the end of the trial, it showed small increase compared with the beginning when in group I it was 15.03 IU $L^{-1}$, in group II 15.11 IU $L^{-1}$ and in group III equaled 14.99 IU $L^{-1}$. Calcium and phosphorus ratio in group I was 2.04 : 1.00, II - 2.00 : 1.00, III - 1.93 : 1.00. The lowest potassium level was in group I - 3.92 mmol $L^{-1}$, in groups II and III respectively by 2.97–3.92 per cent higher ($p<0.001$) (normality 3.5-5.8 mmol $L^{-1}$).

In the blood of dogs from group I, red blood cell count was 6.70 $10^{12}$, or by 8.47 per cent lower (normality 4.0 - 9.0 $10^{12}$ $L^{-1}$) compared to group II ($p<0.01$) and by 10.43 per cent lower compared to group III ($p<0.001$). Comparison with the beginning of the trial showed very small difference, when in group I it was 6.8 $10^{12}$ $L^{-1}$, in group II 7.31 $10^{12}$ $L^{-1}$ and in group III 7.52 $10^{12}$ $L^{-1}$. In contrast to red blood cells, lymphocyte counts in the blood of dogs in group I was the highest, in groups II and III their number decreased (normality 5–30 per cent). Hemoglobin was quite high in all groups. The highest hemoglobin – 168.24 g $L^{-1}$, was in the blood of dogs from group III – by 3.83 per cent higher compared to group I ($p<0.001$) (normality 95 – 150 g $L^{-1}$).

**Discussion.** There are a lot of studies aimed at determining the influence of nutrient fiber on adult obese dogs – nutrient digestibility, loss of body weight and healthiness. Today, obesity in dogs has become a very common problem and is defined as an accumulation of excessive amounts of adipose tissue in the body. Canine obesity prevalence is 24–41 per cent (McGreevy et al., 2005).

We could not find any results of obese dogs losing weight based on feeding manners, fed once or twice per day with free access to the food till they finish the meal comparing with restricted feeding time. Only a few studies on feeding patterns in dogs have been presented in research works in general. (Campell, 1986) reported that slightly below half (46 %) of American dogs examined were fed once daily, 42 % twice per day, and every eighth (12 %) dog was given food at least 3 times daily. (Slater et al., 1992) reported that every fifth dog was fed once, half of the dogs twice, and every eleventh dog three times daily and every fifth dog had access to feed all day. Obviously, this is a reflection of different traditions on how to feed dogs in different countries of the world. Three dog feeding patterns were selected for intensity in weight reduction: feeding once per day - giving daily food intake at once, feeding twice per day - with free access to food, and feeding twice per day - with restricted time of feeding.

Dietary fiber sources for pet food are often grains, fruits and vegetables, celluloses, gums, and other sources. Beet pulp is commonly used as a fiber source in high-quality dog diets (Guevara et al., 2008). The digestibility of sugar beet pulp and other fiber sources is variable, ranging from around 40 per cent to 90 per cent. The low apparent digestibility of many of these materials is explained by their relatively high fiber content and this has been the source of substantial investigation. Initial studies were conducted using cellulose (Burrows et al., 1982) and have subsequently encompassed a range of fibers, including sugar beet pulp, guar gum, inulin, tomato pomace, soybean hulls, selected corn fibers and other carbohydrate sources (Carciofi et al., 2008; Guevara et al., 2008). It has consistently been shown that adding dietary fiber reduces the apparent digestibility of dry matter, organic matter, energy and crude protein by between 2 and 20 per cent. The effects are similar in wet and dry diets and are dose-related. The consensus is that added fiber levels up to 7.5 per cent on a dry matter basis are tolerated well by dogs without adverse effects on digestion. Studies do, however, report a consistent linear increase in both the frequency of defecation and the total weight of faeces produced with incremental inclusion of dietary fiber.

Problems to which obese companion animals may be predisposed include orthopedic disease, abnormalities in circulating lipid profiles, cardiorespiratory disease, urinary disorders, reproductive disorders, neoplasia (mammary tumors, transitional cell carcinoma), dermatological diseases, and anesthetic complications (Kolonin et al., 2004).

Increasing physical activity is a useful adjunct to dietary therapy; when used in combination with dietary therapy, it promotes fat loss and may assist in lean tissue preservation.

During the trial, we watched different weight loss in different periods depending on feeding manners, were the dogs were fed once, twice and with free access to the food or restricted feeding time..At the beginning, weight loss per day was 5.00–5.67 g. During the second period, in group I weight loss was 6.33 g, in group II by 17.47 per cent higher and in group III by 34.54 per cent higher. Fastest weight loss was noticed in group III, during the third period: in group I weight loss per day was 8.00 g, in groups II and III by 1.00–3.00 g higher. Big difference in weight loss in the period of 90–120 days was observed in group I, dogs lost by 12.09 per cent more weight per day compared with dogs in groups II and III. During the next period, the biggest weight loss was in group III, for the dogs fed with restricted feeding time.

The trial was held for six months and during this period the best weight loss per day was calculated in group III: in group I it was by 6.72 g, in group II by 4,68 per cent and in group III by 23.81 per cent higher.

Traditionally, canine weight loss foods have been based on either high dietary fiber (Diez et al., 2002). Simply reducing the caloric content of food with the addition of dietary fiber does not necessarily supply the proper amount of protein turnover during weight loss. In dogs feed diets with different amounts of soluble fiber - 1.0 - 3.0 - 1.6, after 60 days of trial, weight loss observed was respectively - 1268 - 2426 - 2134 g (Yamka et al., 2007). Diets used had negative impact to some of the components in blood - decrease total protein, bilirubin, creatinine, alanine aminotransferase, calcium and potassium.

**Conclussions.** After performing studies with dogs we may confirm that dietary fiber stimulates better absorption of different nutrients, decreases body weight of dogs and enriches healthiness:

- the smallest amount of moisture in faeces was found in dogs fed in the morning and in the evening with restricted feeding time - 60.06 per cent, or by 2.35 per cent lower compared to faeces of dogs fed once per day ($p<0.001$);
- feeding twice per day with free access to food and with restricted feeding time had a positive impact to nutrient absorption at the end of the experiment: crude protein was absorbed at 90.0–88.3 per cent rate, or by 2.4-0.7 per cent better ($p<0.001$), crude fat – 86.9–84.8 per cent, or by 3.1–1.0 per cent better ($p<0.001$), crude fiber – 78.4–75.8 per cent, or by 6.8–4.2 per cent better ($p<0.001$) compared to absorption rate in dogs fed once per day;
- weight loss in dogs fed once per day during 180 days trial period was 1210 g, twice per day with free access to food - 1270 g, with restricted feeding time -1570 g;
- chest and waist measurements were smaller during all periods of the trial in dogs fed twice per day with free access to food and with restricted feeding time;
- total protein amount in the blood of dogs fed once per day was 64.54 g $L^{-1}$, fed twice per day by 0.5 and by 0.9 ($p<0.05$) per cent higher, bilirubin 1.10 µmol $L^{-1}$, or by 3.6-9.1 per cent higher, urea 7.32 mmol $L^{-1}$, or by 3.4-4.4 per cent lower ($p<0.05$);
- erythrocytes count in blood of dogs fed once per day was 6.70 $10^{12}$ $L^{-1}$, fed twice per day with free access – by 9.2 per cent ($p<0.01$) and 11.6 per cent ($p<0.001$) higher with restricted feeding time; hemoglobin count respectively to feeding manner was 162.03 – 164.68 – 168.24 g $L^{-1}$ ($p<0.001$).

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