EFFECT OF NUTRITION ON THE MORPHOMETRIC MARKERS IN SPAYED DOGS

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ABSTRACT

Obesity and overweight have been frequently observed in dogs in recent years as in humans. The compositions of fatty acids in the accumulated lipids in tissues of obese animals may have important roles in the process and mechanisms related to the onset of metabolic disorders. The purpose of this study was to evaluate the effects of a vegetarian diet, which contained a higher proportion of unsaturated fatty acids on individual morphometric parameters in spayed dogs. Seven mongrel dogs without ideal body condition scores (average: 7.42) were fed vegetarian dog kibbles and received the daily amount of energy calculated with the following formula: $130 \text{ kcal} \times \text{weight (kg)}^{0.75}$. The animals were evaluated on days 0 and 60 in relation to the body measurements, such as: body weight, metabolic body weight, body fat percentage, nape, rib, tail base, chest, and abdomen, using a plicometer. Also determined were the body condition scores (scale from 1—thin to 9—obese), canine body mass index, and their waist circumference. These data were analysed by the Student's *t*-test. The body

measurement variation of body fat percentage, waist circumference, body condition score and thickness values of the abdomen differed significantly ($P < 0.01$).

Key words: body condition score; body fat; dog; obesity; overweight

INTRODUCTION

Increased demand for vegetarian animal feeds has raised a response from some companies to produce dry or preserved feeds exclusively from plant components. There are several dry and wet dog foods on the market where only plant components have been used. Feeding with commercial feeds offers more advantages than feeding with home-prepared diets, for example, better nutritional balance of feed rations, time-saving preparation, price and comfort associated with it. Despite these benefits, there are owners who prefer home-prepared diets. These dog owners reported that they feel better when they know what components they use to prepare a feed ration and what their origin is [25].

There are studies where the relationships between metabolic parameters and condition are described. On the other hand, there are only a few studies on dogs dealing with the relationship between castration and condition [7]. Oestrogen plays an important role in the regulation of energy and fat metabolism and affects the condition of dogs. According to P a n [24], castration is one of the significant factors influencing obesity and overweight in dogs. It should be added that there are factors that affect the condition of dogs and factors which need to be taken into account when observing the relationship between sex hormones and the condition of individuals (for example, energy expenditure, type of feed ration, digestibility, age, food intake, breed, reproductive status, and so on) [4, 5, 9, 16, 20]. In addition to the benefits, castration also carries an increased risk of certain diseases [1, 26, 29]. Veterinary researches show that castration increases the risk of being overweight or obesity and this risk is higher if individuals are castrated at an early age (less than six months of age) [13, 15]. Bitches after ovariohysterectomy fed *ad libitum* significantly increased their body weight than bitches after ovariohysterectomy, whose feeding dose was controlled by the exact daily amount [12, 18].

The aim of this study was to provide general information about vegetarian or vegan nutrition in dogs, how to achieve adequate intake of nutrients only from plant components, control of nutritional status in spayed bitches fed this way and monitoring of individual morphometric parameters.

MATERIAL AND METHODS

Animals, diets and experimental design

The project was conducted in 2017–2018 on the total number of seven healthy household spayed bitches which were brought to private veterinary clinic for routine consultations, whose age ranged from 3 to 7 years. These individuals were dewormed. All spayed bitches were cross-breeds of medium height (10.3–27.3 kg). All the animals were submitted to a physical examination and considered free of underlying pathologies. Body composition was determined with the dogs fasting on days 0 and 60. Body condition score (BCS) of each dog was recorded (nine-point rating) [17]. The canine body mass index (CBMI) was calculated according to M ü l e r et al. [22] using the following equation for the calculation:

$$\text{CBMI} = \text{body weight [kg]} / \text{height [m]}^2 \quad (\text{Fig. 1})$$

Measurements were taken from the atlanto-occipital joint to the hind leg limit with the animal in a steady position. Body fat percentage (BF %) was calculated according to B u r k h o l d e r, T o l l [2] using the following equation:

$$\begin{aligned} \text{BF \%} &= \text{BF in females [\%]} \\ &= -1.7 [\text{LRH cm}] + 0.93 [\text{WC cm}] + 5 \end{aligned}$$

where LRH is the length of the right posterior limb from the tuberosity of the calcaneus to the medium patellar ligament and WC is the waist circumference (from the middle point

Fig. 1. Measurement of the body height [22]

Fig. 2. Anatomic sites for measurement of morphometric variables for dogs [2]

between the iliac crest and the last thoracic vertebra, measured with the dog in standing position) (Fig. 2).

Subcutaneous fat was measured using a mechanical caliper at five locations on the body: in the neck, chest, base of the tail, neck and abdomen in mm [28]. All these morphometric measurements and weighings were performed for each dog on the first and last day of the trial period. Commercial vegetarian feed (Table 1) was administered twice daily according to NRC [23] at a daily dose of 130 kcal $\times$ weight [kg] 0.75. The diets were given to the dogs for 60 days at fixed schedule twice a day. The basic ingredients of the feed were: wheat, soybeans, corn, sunflower seeds, wheat semolina, minerals, brewer's yeast. All feed ingredients came from controlled organic farming. Water was administered *ad libitum*.

ETHICAL CONSIDERATIONS

The owner of the dogs gave permission to conduct this study. The relevant animal welfare legislative provisions were met while handling the experimental animals.

Table 1. Chemical composition of the experimental diets (% dry matter)

Item	Composition
Dry matter	92.68 %
Crude protein	20.4 %
Fat	12.2 %
Crude fibre	7.0 %
Ash	7.4 %
Calcium	1.2 g.kg ⁻¹
Phosphorus	0.9 g.kg ⁻¹
Metabolizable energy	3670 kcal.kg ⁻¹

Statistical analysis

The results were reported as means $\pm$ SD (standard deviation). The differences between means were determined according to the paired *t*-test (Graph-Pad Prism program, version 5, USA). By conventional criteria, the differences $P < 0.05$ were considered to be of statistical significance.

RESULTS

In this study, we observed a decrease in the body fat and waist circumference in dogs fed the selected diet ($P < 0.01$). As these values decreased, a decrease in BCS from 7.42 to 6.28 was also noted ($P < 0.01$). No statistical significance was noted between the two measurements at body and metabolic weight ($P > 0.05$) (Table 2). For body condition score, body fat, abdominal circumference and subcutaneous fat in the abdomen, statistical significance was recorded between the two measurements ($P < 0.01$) (Table 2). When measuring subcutaneous fat in the neck, neck, chest and base of the tail, the difference was not statistically significant ($P > 0.05$) (Table 2).

DISCUSSION

The aim of this research was to investigate morphometric markers in spayed dogs fed by vegetarian diet which contained a higher proportion of crude fibre. Fibre is commonly used in commercial dry dog and cat foods due to their several important physiological functions, such as improvement of gastrointestinal health and function, reduction in the nutrient digestibility and energy value of the food and alterations in digesta mean retention time [14, 19, 21]. Fritsch et al. [10] pointed out in his study that

Table 2. Average of body measurements on days 0 and 60 observed in dogs fed vegetarian feed

	BW	MW	CBMI	BCS	BF	WC	Nape	Rib	Chest	AB	TB
Day 0	14.80	7.45	14.82	7.42	27.93	51.42	9.00	6.28	6.35	6.85	10.07
Day 60	14.25	7.22	14.34	6.28	26.34	49.71	8.57	5.00	5.00	3.42	8.57
P	0.18	0.17	0.38	0.004	0.003	0.003	0.48	0.17	0.24	0.005	0.28
SEM	0.36	0.14	0.74	0.26	0.33	0.35	0.57	0.83	1.05	0.81	1.27

BW—body weight; MW—metabolic weight; CBMI—canine body mass index; BCS—body condition score; BF—body fat; WC—waist circumference; AB—abdomen; TB—tail base; SEM—standard error of the mean; P—significant differences at $P < 0.05$

the condition of dogs fed with a higher fibre content in the diet, they lose weight more easily than individuals with ideal BCS, because they have a higher % of subcutaneous fat to mobilize and compensate for energy deficiency. The diet contained a higher proportion of fibre, because it was a feed composed exclusively of plant components. The addition of fibre in the diet formulated for dogs can affect the viscosity of food intake, peristalsis of digestion in the digestive tract, the feeling of satiety, digestibility of nutrients, can affect the bacterial population of the colon. A higher proportion of fibre in the feed ration may be useful in the prevention and treatment of diseases such as diabetes and obesity [6]. Fibre can be classified based on the way it reacts with water (soluble or insoluble) or based on the fermentability (high, medium and low) associated with the degradation of the substrate by anaerobic bacteria [8]. Soybeans, as a source of insoluble fibre, can affect faecal consistency, digestion rate in the digestive tract, reduce the incidence of constipation, and reduce nutrient absorption [3].

The BCS is an important tool to determine the nutritional status of dogs in clinical cases [27]. The BCS assessment was performed using the validated 9-point BCS scale, where 1—3 was considered underweight, values between 4–5 ideal, values between 6–7 as overweight and values between 8–9 were evaluated as obesity [17]. The use of techniques such as BCS measurement, subcutaneous fat measurement using a mechanical caliper (in the neck, chest, base of the tail, neck and abdomen) and anthropometric measurements (stem circumference) are the most common evaluation methods for calculating and determining subcutaneous fat [11]. If 15 to 25 % body fat is accepted as optimal for dogs and cats, then an animal with a BCS of 4—5 out of 9 (4—5/9) should have about 20 % body fat. Dogs with body fat more than 25 % are considered as overweight or obese [2]. In our study we recorded average body fat 27.93 % what we can consider as overweight.

CONCLUSIONS

When monitoring morphometric indicators before and after the administration of vegetarian feed in spayed bitches, we observed statistically significant changes in body condition score, waist circumference, % of body fat and subcutaneous fat thickness in the abdomen. We did not record statistically significant changes in the other in-

dicators. These simple measurements are used to objectively assess the nutritional status not only in dogs but also in cats.

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