Effects of Weight Loss and Feeding a High-Protein, High-Fiber Diet on Blood Metabolite Profiles, Body Composition, and Voluntary Physical Activity in Overweight Dogs

Thunyaporn Phungviwatnikul[1,4], Sara E. Belchik[1], Kelly S. Swanson[1,2,3]

[1]Department of Animal Sciences, [2]Division of Nutritional Sciences, and [3]Department of Veterinary Clinical Medicine, University of Illinois at Urbana-Champaign, Urbana, IL USA; [4]Perfect Companion Group Co., Ltd., Thailand

INTRODUCTION

- Obesity is a highly prevalent disease in dogs.
- From 2007 to 2018, the percentage of obese and overweight dogs increased from 43% to 55.8% (APOP, 2007; APOP, 2018).
- Clinical obesity increases the risk of several comorbidities (e.g., chronic inflammation, diabetes), which may be managed by energy restriction using a specially formulated weight loss diet.

OBJECTIVE AND HYPOTHESIS

- To determine the effects of weight loss on body composition, voluntary physical activity, and blood metabolites of overweight dogs fed a high-protein, high-fiber diet.
- We hypothesized that weight loss would increase voluntary physical activity, reduce body fat mass and blood lipids, and result in serum biochemical parameters within, or closer to, normal ranges.

MATERIALS AND METHODS

- **Experimental Design**
  - 12 overweight adult spayed female dogs (BW: 15.3 ± 2.1 kg, BCS: 8.1 ± 0.6).
  - All dogs were fed a high-protein, high-fiber diet during a 5-wk baseline phase to identify food intake needed to maintain BW.
  - A 24-wk weight loss phase then followed.
  - Food was initially provided at 80% the amount needed to maintain BW and was then adjusted weekly with a goal of 1.5-2% weight loss per wk.
- **Data Analysis**
  - Data were analyzed statistically over time using SAS 9.4, testing the effects of time.

MATERIALS AND METHOD

- **Experimental Diet**

Table 1. Chemical composition of experimental diet

Item	
Dry matter (DM), %	92.47
	----- % DM -----
Organic matter	89.65
Ash	10.32
Crude protein	42.04
Acid-hydrolyzed fat	12.14
Crude fiber	3.90
Total dietary fiber	26.81
Nitrogen-free extract	8.69
Metabolizable energy (ME), kcal/g	2.81
Gross energy, kcal/g	4.49
Macronutrients on energy basis (% ME)	
- Protein	52.41
- Fat	36.76
- Carbohydrate	10.83

- **Measurements and Laboratory Analysis**

Figure 1: Hologic QDR 4500 Elite Acclaim Series

  - BCS was evaluated using a 9-point scale (Laflamme, 1997).
  - Body composition was evaluated by dual-energy x-ray absorptiometry (DEXA: Hologic QDR 4500 Elite Acclaim Series) (Figure 1).
  - Voluntary physical activity was measured by Actical® devices and computer software (Mini Mitter, Bend OR).
  - Serum chemistry profile and complete blood count were analyzed using a Hitachi 911 clinical chemistry analyzer (Roche Diagnostics, Indianapolis, IN) at the University of Illinois Veterinary Medicine Diagnostics Laboratory.
  - Serum leptin was measured using an ELISA kit (#EZCL-31K, Millipore, Billerica, MA).

RESULTS

Table 2. Complete blood cell counts and serum metabolites of overweight adult female dogs fed an experimental diet while undergoing weight loss

Variables	wk0	wk6	wk12	wk18	wk24	Reference[1]	SEM	P-values
Serum chemistry panel								
Creatinine, mg/dL	0.51^{b}	0.52^{b}	0.55^{ab}	0.57^{a}	0.57^{a}	0.5-1.5	0.011	0.0022
BUN[2], mg/dL	11.25^{c}	11.33^{c}	12.17^{bc}	13.25^{ab}	14.33^{a}	6-30	0.324	<0.0001
Total ALP[2], U/L	46.08^{a}	34.83^{b}	32.58^{bc}	27.92^{d}	28.08^{cd}	7-92	3.158	<0.0001
CALP[2], U/L	22.33^{a}	15.83^{b}	15.00^{b}	13.83^{b}	12.25^{b}	0-40	3.086	<0.0001
Total bilirubin, mg/dL	0.14^{c}	0.18^{b}	0.19^{ab}	0.22^{ab}	0.23^{a}	0.1-0.3	0.005	<0.0001
Total cholesterol, mg/dL	189.25^{xy}	190.17^{xy}	191.08^{x}	178.83^{xy}	177.50^{y}	129-297	6.600	0.0787
Triglycerides, mg/dL	59.58^{a}	54.75^{ab}	50.75^{ab}	48.50^{b}	46.25^{b}	32-154	1.745	0.0011
Complete blood cell counts								
Total white blood cells, 10^6/μL	8.01^{a}	7.12^{a}	6.96^{a}	5.61^{b}	5.24^{b}	6-17	0.244	<0.0001
Neutrophils, 10^3/μL	5.97^{a}	5.23^{ab}	4.98^{ab}	4.11^{bc}	3.62^{c}	3-11.5	0.198	<0.0001

[1] University of Illinois Veterinary Diagnostic Laboratory Reference Ranges.
[2] BUN: blood urea nitrogen; Total ALP: total alkaline phosphatase; CALP: corticosteroid isoenzyme of ALP.
[a-j] Mean values within the same row with unlike superscript letters differ (P < 0.05).
[x-z] Mean values within the same row with unlike superscript letters tend to be differ (P < 0.10).

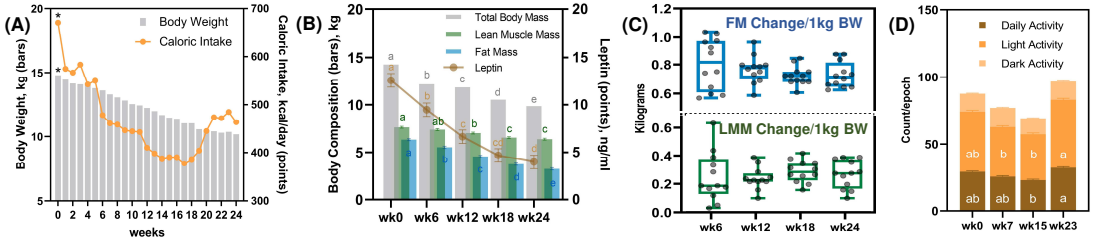

Figure 2: Body weight and caloric intake (A); body composition and leptin concentration (B); fat mass (FM) change and lean muscle mass (LMM) change per kg BW (C); voluntary physical activity (epoch duration, 15 seconds) (D) of overweight dogs from wk0 to wk24. *Mean values differ from other time points (P<0.01). [a-e]Mean values with unlike letters differ (P<0.01).

- After 24 wk, dogs lost 31.2% of initial BW (P<0.0001), with 1.4 ± 0.7% weight loss per wk.
- BCS decreased by 2.8 units (P<0.0001). During weight loss, dogs consumed an average of 457.5 ± 61.4 kcal/d, with energy intake being reduced by a total of 43.8% by wk 24 compared to baseline.

CONCLUSIONS

- Our results suggest that a high-protein, high-fiber diet promotes fat mass loss, reduces blood immune cell counts, and reduces circulating liver enzyme, leptin, and triglyceride concentrations in overweight dogs. Therefore, this dietary formulation is a suitable nutritional option to include in a weight loss program for dogs.

ACKNOWLEDGEMENTS

- Perfect Companion Group Co., Ltd. (Thailand) funded this project.