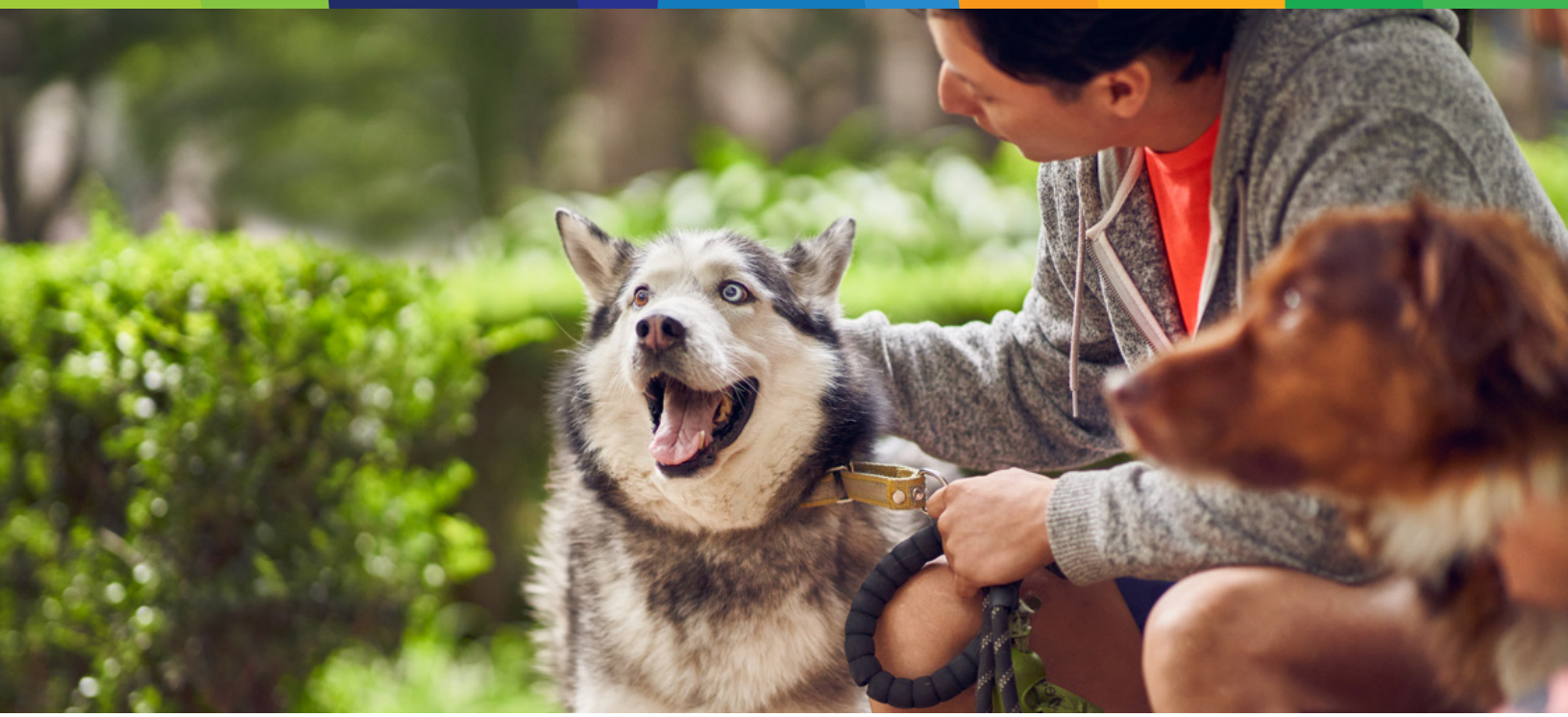
TECHNICAL BULLETIN

PLANT & YEAST PROTEIN FOR DOGS: CATERING TO FLEXITARIAN AND VEGETARIAN LIFESTYLES



The pet food industry is continually challenged with anticipating future trends and addressing evolving expectations from pet parents.

Trends within the human food industry are often used to predict future opportunities in the pet food market. Drawing insights from trends in the human food industry, one noteworthy development is the rise of the flexitarian dietary pattern. Flexitarians consciously reduce meat intake without completely eliminating it, opting for plant-based proteins as substitutes (Euromonitor, 2019). This shift is creating a demand for alternative protein sources in pet foods. Additionally, there is growing interest from sustainability-minded consumers in incorporating alternative ingredients to complement or replace traditional animal proteins used in today's pet foods and treats.

In response to these trends, ADM conducted a canine feeding study to better understand the nutritional value of flexitarian and vegan dog foods compared to a conventional dog food containing animal-based protein. The study used 32 adult American Foxhound dogs assigned to one of four test foods (8 dogs/food). A conventional premium-quality dog food containing animal-based protein as the main protein source served as the control food (CON). Two flexitarian foods were formulated to provide 12% of total protein from animal-based protein with the balance from dried yeast and either pea protein (FLEX-PEA) or soy protein (FLEX-SOY). A vegetarian food, without animal or soy ingredients, contained dried yeast, corn gluten meal and pea protein as the protein sources (VEGAN). The ingredient composition of the diets is shown in Table 1. The objective of the study was to assess the impact of these foods on palatability, acceptability, digestibility, stool quality, and the fecal microbiome. The results of this study are valuable for the development of pet foods that are nutritionally complete and align with the evolving expectations, health considerations and growing eco-consciousness of today's pet owners.

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Table 1. Ingredient and nutrient composition of test foods.

TEST DOG FOODS	CONVENTIONAL	FLEXITARIAN		VEGETARIAN
	CON	FLEX-PEA	FLEX-SOY	VEGAN
Protein contribution (%)				
Animal sources	75	12	12	0
Plant/yeast sources	25	88	88	100
Protein ingredients (%)				
Poultry meal	30.8	4.0	4.0	-
Dried yeast	0.5	18.0	11.2	19.0
Corn gluten meal	3.7	9.7	8.0	13.8
Pea protein concentrate	-	2.0	-	2.0
Soy protein concentrate	-	-	4.0	-
Soy flour	-	-	5.0	-
Other ingredients (%)				
Cereals[a]	47.1	41.9	44.5	40.6
Fats & oils[b]	7.5	9.4	9.4	9.3
Miscellaneous[c]	10.3	15.0	13.9	15.3
Nutrient composition				
Moisture (%)	9.9	9.5	9.0	7.0
Protein (%)	27.0	23.3	23.6	23.4
Fat (%)	15.5	13.2	12.4	13.4
Ash (%)	7.0	6.9	5.5	5.4
Insoluble fiber (%)	8.6	14.4	15.2	16.5
ME (Kcal/100g)	386	363	364	363

[a] *Corn, sorghum, rice*
[b] *Poultry fat, sunflower oil, fish oil, DHA*
[c] *Beet pulp, inulin, FOS, salt, vitamins, minerals, palatants*

PALATABILITY AND ACCEPTABILITY TRIALS

Two-bowl, two-day palatability trials were conducted to compare each test food with CON. The FLEX-PEA and FLEX-SOY foods exhibited significantly higher intake than CON, while there was no significant difference between VEGAN and CON. To replicate typical in-home feeding practices and to gauge the longer-term attractiveness of the foods, monadic acceptance tests and a 21-day intake evaluation were conducted. In monadic tests, no significant differences in food intake were observed among the four foods, with total food consumption exceeding 98% for each diet. Consistent food intake across all diets was maintained throughout the 21-day evaluation, with no indication of monotony observed.

STOOL QUALITY AND NUTRIENT DIGESTIBILITY

Fecal score and output are reported in Table 2. Fecal samples were scored according to the following scale: 0 = watery diarrhea; 1 = very moist, has texture but no shape; 2 = very moist, has shape; 3 = firm and moist, well-defined shape; 4 = firm but not hard; 5 = very hard, dry. While VEGAN exhibited the highest fresh fecal mass, there was no statistically significant difference in dried feces between the CON and VEGAN diets. These results align with the higher dietary fiber levels in the VEGAN food, as fiber contributes to increased fecal moisture. Despite variations in fecal quantity, it is noteworthy that all diets maintained average fecal quality scores between 3.5 and 3.8, indicating well-formed stools across all foods.

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Apparent total tract nutrient digestibility was evaluated using the Association of American Feed Control Officials (AAFCO) total collection method, involving a five day adaptation period followed by five days of total stool collection. Dogs were fed once a day to meet maintenance energy requirements based on National Research Council recommendations. Apparent nutrient digestibility coefficients are shown in Table 3. Dry matter digestibility was lower for VEGAN compared to CON, with no significant differences observed between the two FLEX foods and CON. FLEX-SOY and CON had similar protein and fat digestibility values, while VEGAN and FLEX-PEA exhibited similar, but lower values, than the other two diets. Overall, all diets maintained nutrient digestibility coefficients within the typically accepted range for premium dog foods.

Table 2. Mean fecal output and stool quality of dogs fed control, flexitarian or vegetarian foods.

	CON	FLEX-PEA	FLEX-SOY	VEGAN
Fecal output, fresh (g/day)	218^{a}	304^{ab}	237^{a}	328^{b}
Fecal output, dried (g/day)	72^{ab}	87^{ab}	64^{b}	92^{b}
Fecal quality[1]	3.5^{a}	3.6^{ab}	3.7^{ab}	3.8^{b}

^{ab} Means with different superscripts are statistically different based on Tukey test (P<0.05).
[1] Fecal quality scoring:
0 = watery diarrhea; 1 = very moist, has texture but no shape; 2 = very moist, has shape;
3 = firm and moist, well-defined shape; 4 = firm but not hard; 5 = very hard, dry

Table 3. Apparent total tract digestibility of dogs fed control, flexitarian or vegetarian foods.

DIGESTIBILITY, %	CON	FLEX-PEA	FLEX-SOY	VEGAN
Dry matter	82.1^{ab}	79.6^{bc}	83.9^{a}	79.1^{c}
Protein	85.2^{a}	82.0^{c}	84.7^{ab}	82.6^{bc}
Fat	92.3^{ab}	91.2^{ab}	92.9^{a}	90.4^{b}
Starch	88.0^{a}	83.5^{b}	88.6^{a}	82.8^{b}
Digestible energy	4,500^{ab}	4,227^{bc}	4,339^{ab}	4,145^{b}
Metabolizable energy	4,151^{a}	3,961^{bc}	4,060^{ab}	3,873^{bc}

^{abc} Nutrient means with different superscripts are statistically different based on Tukey test (P<0.05).

FECAL MICROBIOTA

Dogs were randomly assigned to receive one of the four test diets exclusively for 21 days. Following this period, fecal samples were collected for microbiome analysis using 16S rRNA PCR amplicon sequencing. The goal was to quantify the number of sequences corresponding to each detected taxa and compare the microbiome composition among dogs receiving the different dietary treatments.

Microbiome analysis revealed no differences in alpha diversity between the CON, FLEX-SOY and VEGAN foods. However, the FLEX-PEA diet resulted in a reduction in diversity. Additionally, principal component analysis demonstrated marked changes in the fecal microbiome of dogs fed the FLEX-SOY, FLEX-PEA and VEGAN foods. Notably, these changes were characterized by the presence of at least one bacterial taxa associated with canine health.

KEY TAKEAWAYS

The study results demonstrate that flexitarian and vegetarian dog foods, formulated with low or no inclusion of animal-sourced ingredients, can effectively meet the nutritional needs of adult dogs. These diets were shown to be palatable, digestible, and supported microbiome richness. This implies that carefully designed plant-based or flexitarian dog foods are viable alternatives for providing adequate nutrition while positively influencing the diversity of the gut microbiome in dogs.

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