

เจาะลึก Novel protein:

จาก “ทางเลือก” สู่ “ความจำเป็น” ของระบบอาหารโลกยุคใหม่

1st July 2026, 9.00-10.00 @ Novotel Bangkok, Future Park Rangsit, Thailand

Presented by Assoc.Prof.Dr.Attawit Kovitvadhi (D.V.M., PhD)

CEO of ANLAR service Co., Ltd.

Associate editor of Journal of Insects as Food and Feed

Guest editor of Animals (Special issue: Small Animal Nutrition and Health)

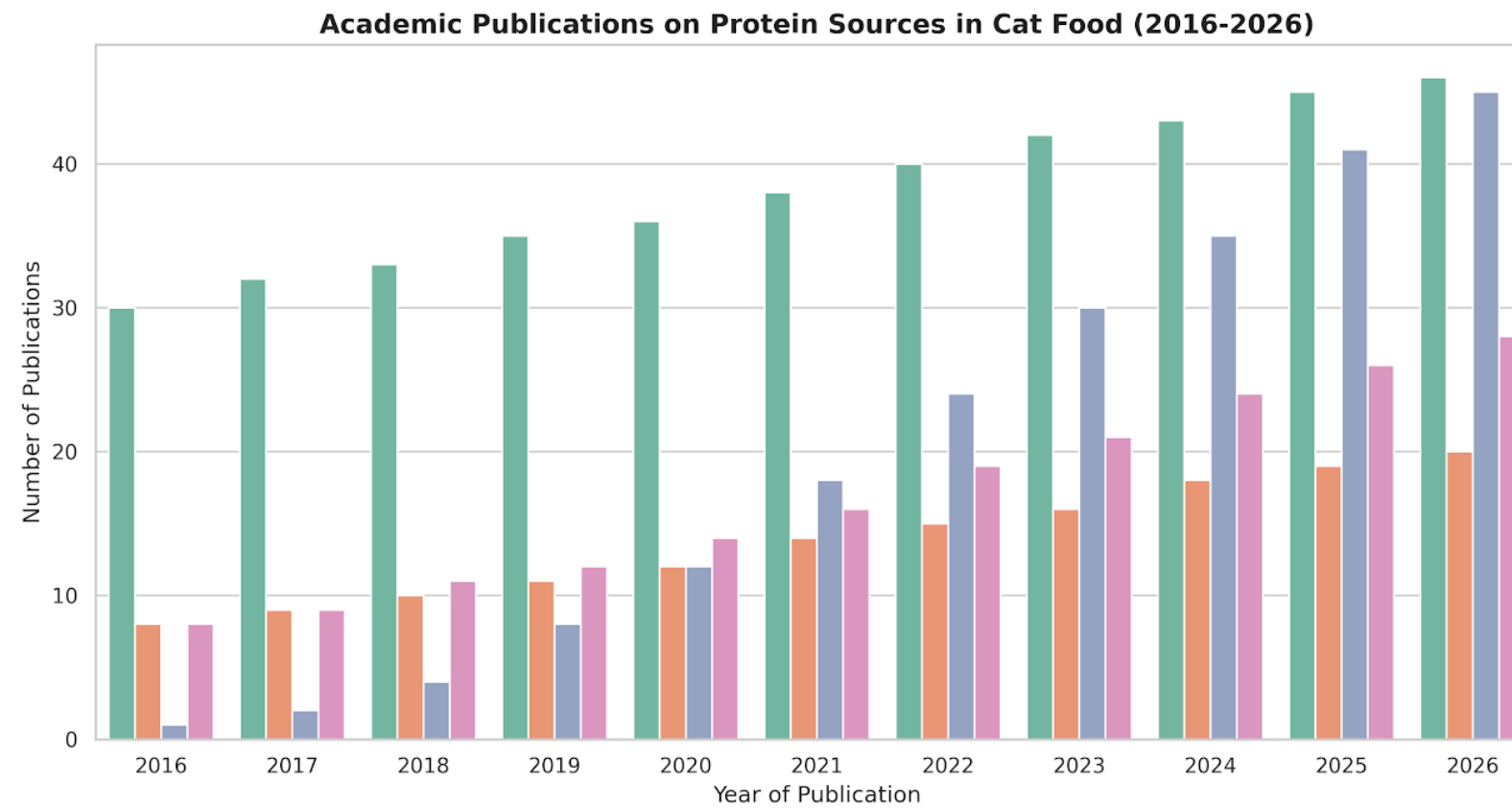
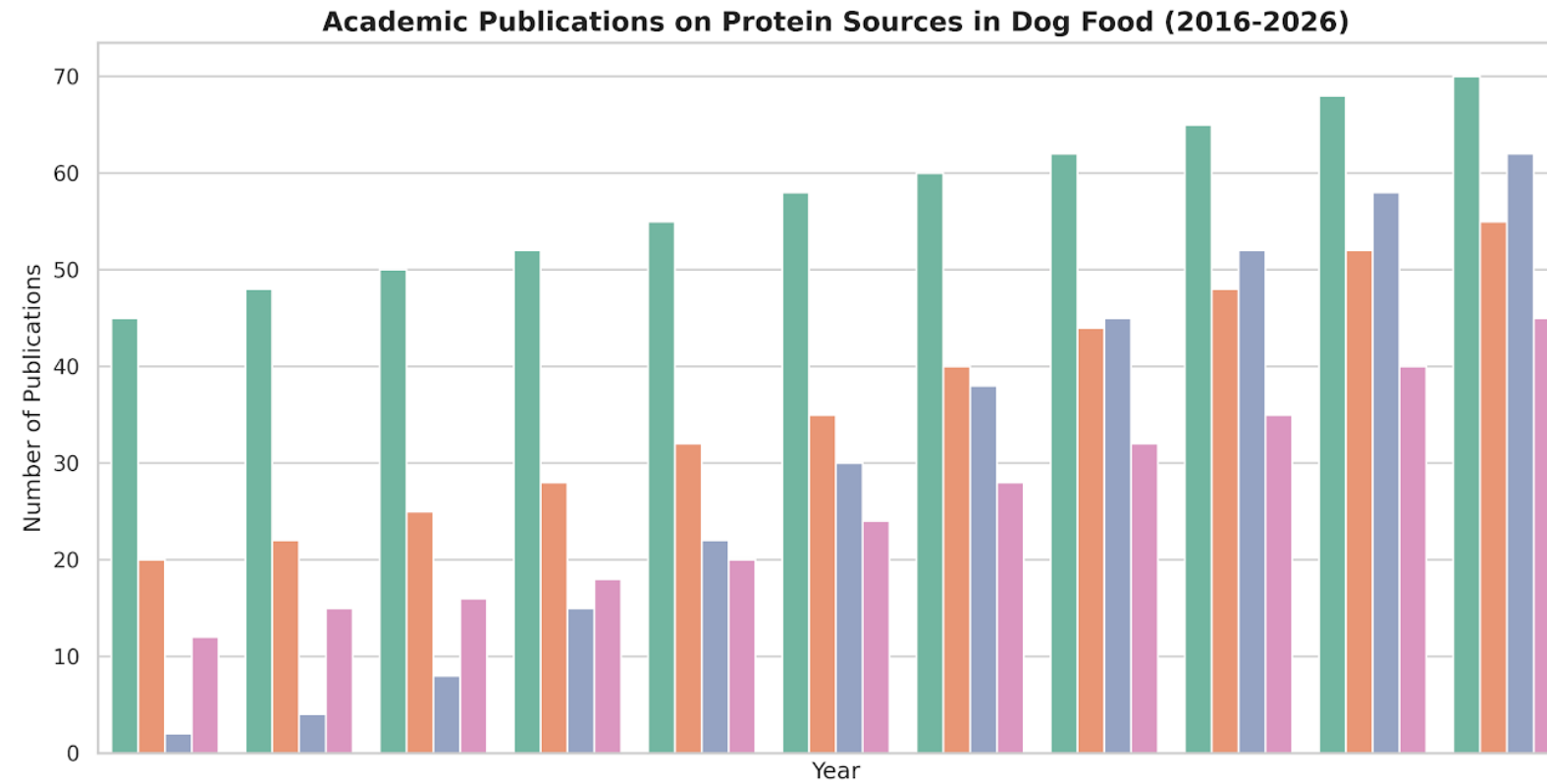
attawithai@gmail.com



- ค้นหาแหล่งโปรตีนทางเลือกที่มีศักยภาพสูง
- เปรียบเทียบคุณภาพของ Novel protein ในมิติต่างๆ
- ประเด็นท้าทายในการประยุกต์ใช้ Novel protein ในระดับอุตสาหกรรม

Number of publication on protein sources in dogs and cats

Scopus®



The push to find alternative protein sources for dogs and cats



1. Environmental sustainability

- Traditional livestock farming is resource-intensive (land & water) and greenhouse gas emissions.

2. Managing food allergies and sensitivities

- Protein can trigger the allergic skin, digestion and others.

3. Global resource competition (Food security)

- Increase of human and pet population

4. Ethical and animal welfare concerns

- Uncomfortable with the realities of traditional factory farming

5. The "Humanization" of pets

Food allergy



Steps of diagnostic and treatments in atopic dermatitis

1. Infection

- Parasite, Bacteria, Yeast and others

2. Environment

- Contact dermatitis
- Inhalation
- Surround environment

3. Food allergies

- Test by food challenges
 - Anallergenic diet (<5,000-10,000 Daltons)
 - Challenge back to identify the allergen
 - Anallergenic diet (<5,000-10,000 Daltons)
 - Hypoallergenic diet or Novel protein sources

4. Immune related problems

- Chlorpheniramine
- Oclacitinib
- Immunosuppressive drugs

Table 2. Foods Reported to Cause Allergies in Dogs & Cats

	Common Foods	Uncommon Foods
Dogs	<ul style="list-style-type: none">• Beef• Chicken• Corn• Dairy• Egg• Soy• Wheat	<ul style="list-style-type: none">• Fish• Lamb• Pork• Rabbit
Cats	<ul style="list-style-type: none">• Beef• Dairy• Fish	<ul style="list-style-type: none">• Barley• Egg• Lamb• Pork• Poultry• Rabbit• Wheat

Protein requirement in dogs (Life stage)



Values refer to diets containing 4.0 kcal ME/g.	
Age Range	Crude Protein (g/kg Diet)
Growing	
4-14 Weeks	180
6-10 Weeks	172
7-40 Weeks	200
8-10 Weeks	150-200
8-14 Weeks	140
8-16 Weeks	230-275
13-17 Weeks	117
>14 Weeks	140
18-20 Weeks	250
Adult	
Not Specified	35 to 90 ¹
Not Specified	138
Not Specified	<160
Senior	
8 Years	<160
12–13 Years	188

Protein levels and quality (Digestibility) in cats



Fecal Microbiota

- Increasing the dietary protein concentration did not affect the alpha diversity of the fecal microbiota.
- A lower dietary protein quality slightly increased the evenness index , but had no effect on richness or the Shannon index.
- **Increasing** dietary protein concentrations
 - **Increased** *Fusobacterium*, *Bacteroides*, and *Parabacteroides*
 - **Decreasing** *Prevotella*, *Erysipelothrichaceae*, *Faecalibacterium* and *Phascolarctobacterium*.
- **Lower** dietary protein quality
 - **Increased** *Fusobacteria* and *Bacteroidetes*, *Prevotella*, *Fusobacterium*, *Ethanoligenes* and *Clostridium coccoides* cluster XIVa

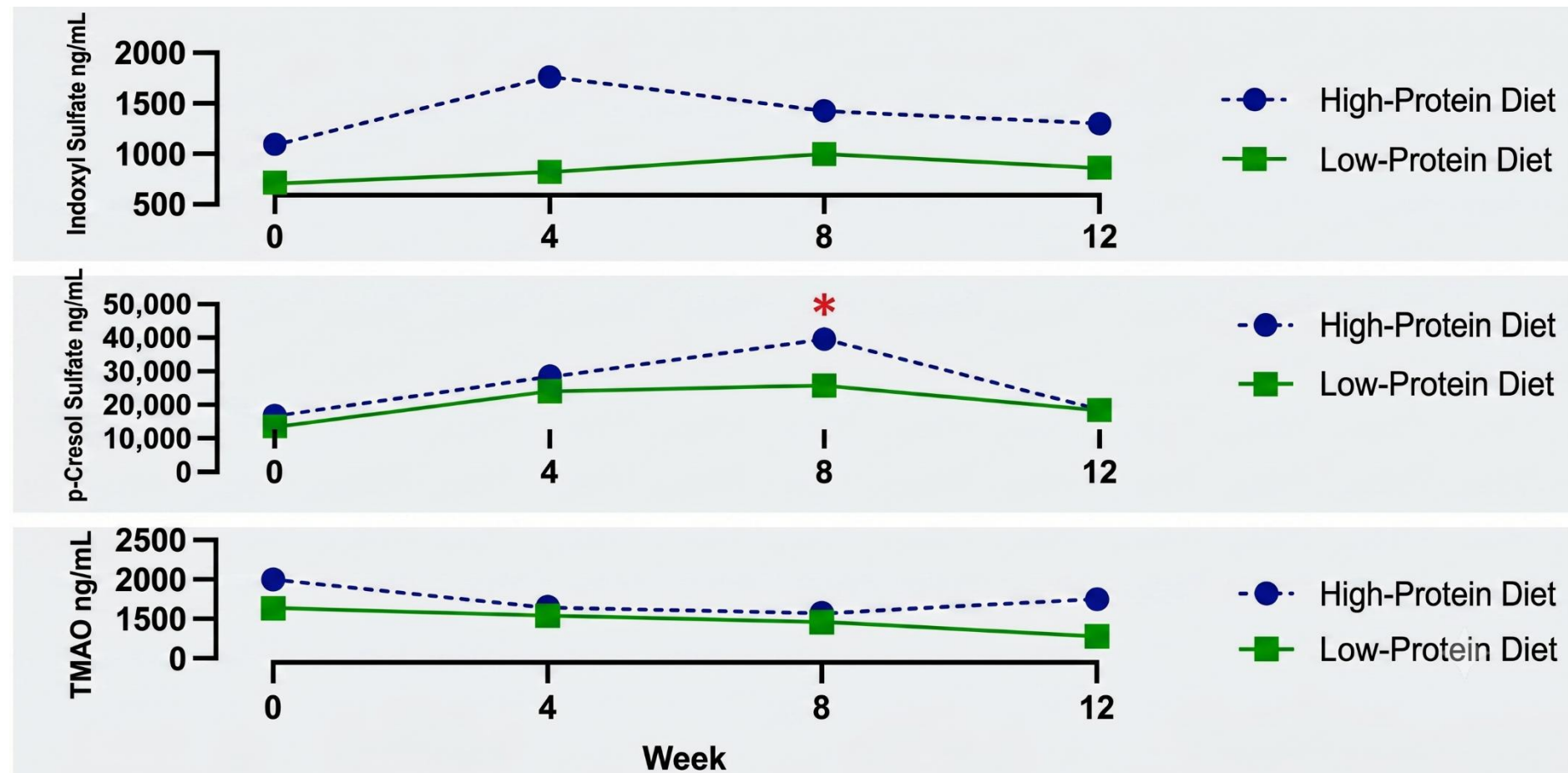
Fecal Microbial Metabolites

- **Increasing** dietary protein concentrations
 - **Increased** ammonium, i-valeric acid and n-valeric acid
 - **Decrease** histamine, cadaverine, total biogenic amines and propionic acid

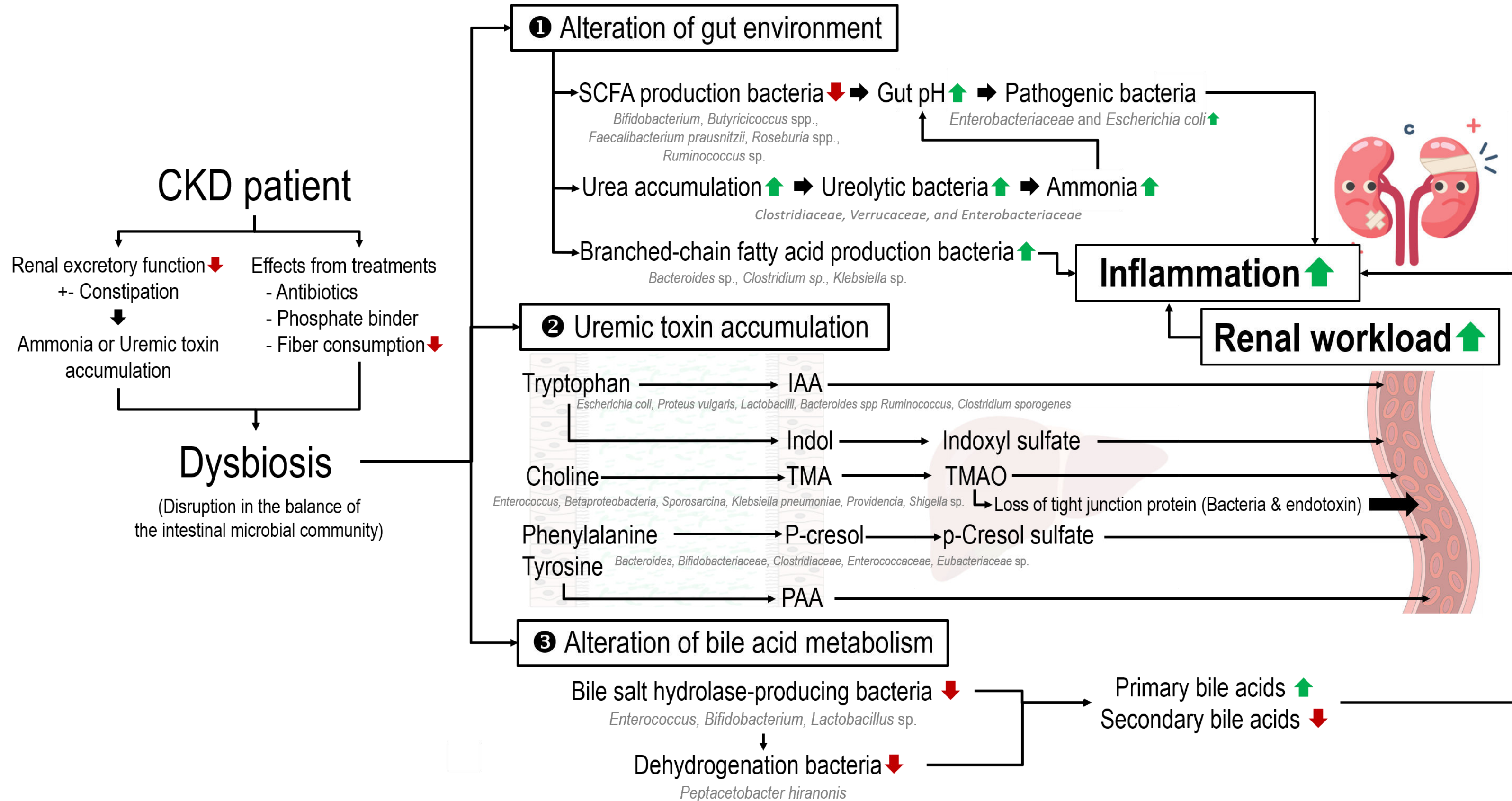
Protein levels and Uremic toxin in cats



- The intestinal microbiome is critical for maintaining host health and preventing disease
 - Dietary nutrients heavily influencing its composition and function.
- Gut-derived uremic toxins
 - Indoxyl sulfate (IS), p-cresol sulfate (PCS) and trimethylamine-n-oxide (TMAO) are produced through the colonic microbial fermentation of amino acids.



Uremic toxin



Current novel protein in dog and cat nutrition



1. Exotic and non-traditional meats: Alligator, Crocodile, Kangaroo, Rabbit, Ostrich, Frog and Fresh water fish
2. Vegetable protein
3. Invertebrate protein (Insects): Black soldier fly larvae, Mealworms and Crickets
4. By-products with processing (Hydrolysate protein): Tuna, Shrimp, Squid, Poultry, Gelatin and others
5. Aquatic plants and Macroalgae: Duck weed and Spirulina
6. Single cell protein: Fungi (Mycoprotein: *Fusarium venenatum*), Bacteria, Microalgae (*Chlorella vulgaris*)
7. Protein fermentation: brewed lamb protein or brewed chicken protein was produced from yeast
8. Cultured meat

1. Exotic and non-traditional meats



Nutritional Comparison of Meat Sources (per 100 g edible portion)

Categories	Protein Source	Protein (g)	Fat (g)
Common	Chicken	18.9	10
	Beef	20.4	11
	Pork	20.1	9
Alternative	Alligator (Caiman)	20.8	0.5–2.4
	Kangaroo	20.0–25.0	< 2.0
	Rabbit	16.5–26.2	0.4–8.8

1. Exotic and non-traditional meats



Amino Acid Profile Comparison

Category	Source	Completeness	Key Amino Acid Characteristics
Common			
	Chicken	Complete	High digestibility (PDCAAS ~1.0); rich in BCAAs (leucine, isoleucine, valine).
	Beef	Complete	High digestibility (PDCAAS ~1.0); provides all 9 EAAs in optimal physiological ratios.
	Pork	Complete	High digestibility (PDCAAS ~1.0); provides all 9 EAAs.
Alternative			
	Tuna	Complete	EAAs represent ~52.3% of the total amino acid pool; notable for high histidine and lysine.
	Alligator & Crocodile	Complete	Total amino acids make up 81.1–86.5% of crude protein; profile is comparable to beef.
	Kangaroo	Complete	Highly digestible with an excellent EAA profile; frequently used in hypoallergenic diets.
	Rabbit	Complete	Lysine is the dominant EAA (up to 13.5 g/100g protein); exceptionally rich in isoleucine.
	Ostrich	Complete	Ultra-lean protein with a comprehensive EAA profile.
	Frog	Complete	Rich in lysine, methionine, and threonine (total EAA sum is higher in cultured vs. wild frogs).
	Tilapia	Complete	Sufficient EAAs to meet adult human requirements; glutamine is the most abundant amino acid.

2. Insect proteins: Silkworm pupae & House cricket



“These insects can
used in dog diets.”

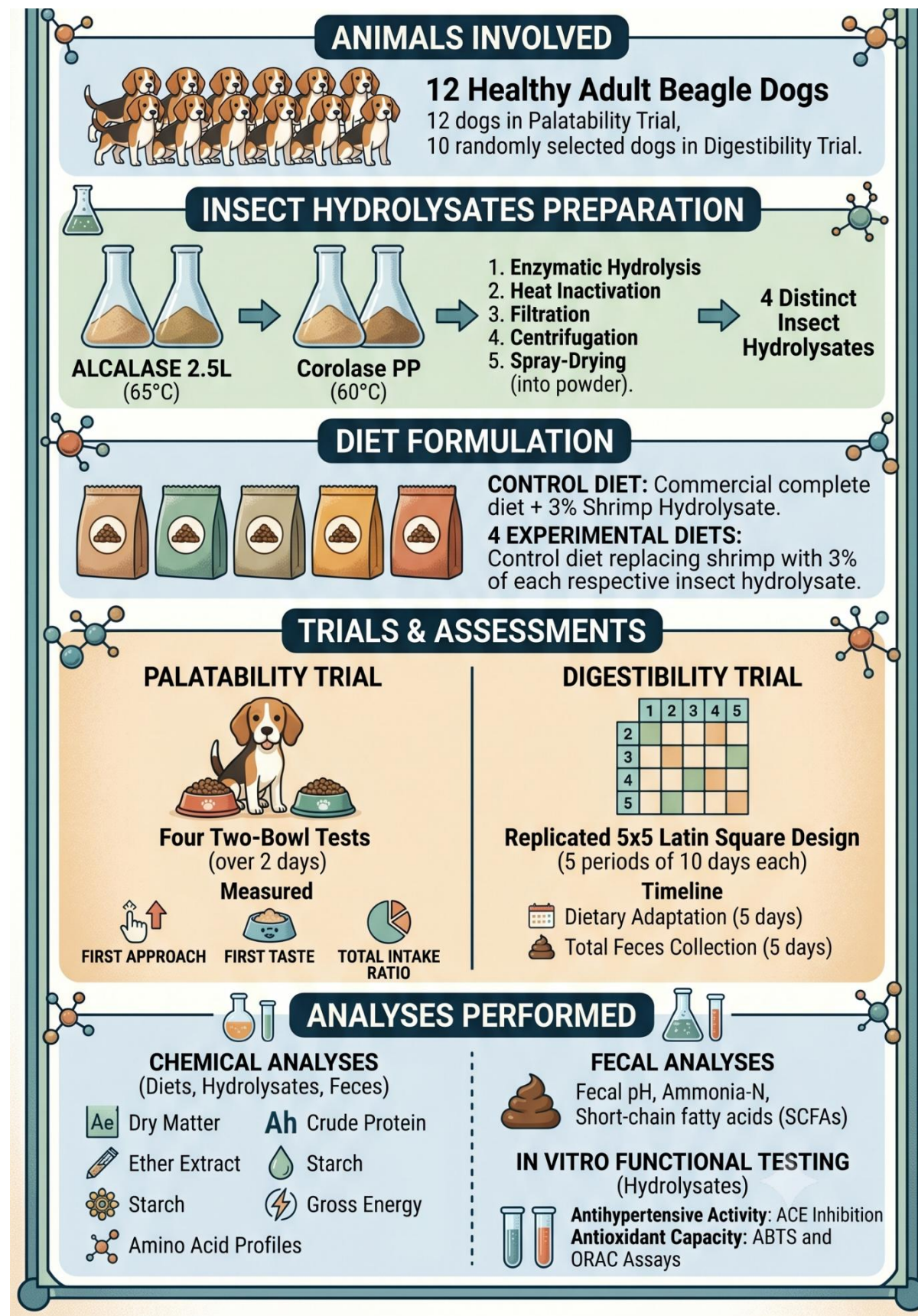
Five groups

1. Control (Meat & Bone meal)
2. Cricket meal at 10%
3. Cricket meal at 20%
4. Silkworm pupae meal at 7%
5. Silkworm pupae meal at 14%



Genus	Group Con	% Cricket		% Silkworm		p-value
		10	20	7	14	
<i>Allobaculum</i>	14.2±5.50 ^b	13.7±4.96 ^b	11.6±3.70 ^b	11.1±4.33 ^b	3.44±1.27 ^a	0.040
<i>Bacteroides</i>	1.00±0.42	0.74±0.28	0.49±0.09	0.71±0.20	0.62±0.34	0.570
<i>Bifidobacterium</i>	5.56±1.71	7.42±1.60	6.68±1.33	8.01±2.09	4.41±0.91	0.479
<i>Blautia</i>	2.62±0.61	2.16±0.44	1.83±0.27	2.50±0.64	2.07±0.48	0.745
<i>Catenibacterium</i>	2.61±0.85	2.39±1.05	0.93±0.39	1.03±0.17	1.37±0.60	0.268
<i>Clostridium_sensu_stricto_1</i>	1.88±0.37	1.25±0.29	2.89±1.01	1.22±0.31	2.07±0.63	0.517
<i>Collinsella</i>	1.58±0.34	2.46±0.59	1.56±0.17	2.56±0.51	1.94±0.39	0.327
<i>Corynebacterium</i>	0.83±0.27 ^a	1.09±0.38 ^a	0.61±0.14 ^a	0.76±0.12 ^a	2.67±0.91 ^b	0.021
<i>Erysipelatoclostridium</i>	0.46±0.12	0.59±0.09	0.52±0.07	0.42±0.05	0.64±0.12	0.210
<i>Faecalibacterium</i>	0.92±0.37	1.06±0.47	0.50±0.11	0.47±0.10	0.59±0.27	0.260
<i>Fusobacterium</i>	1.51±0.66	0.62±0.34	1.65±0.75	0.65±0.36	0.26±0.08	0.445
<i>Holdemanella</i>	3.04±0.62	3.01±0.72	1.64±0.50	3.50±0.93	3.56±0.91	0.099
<i>Lactobacillus</i>	12.4±2.58 ^a	20.5±4.70 ^a	23.7±4.12 ^{ab}	23.1±4.53 ^{ab}	34.2±2.89 ^b	0.024
<i>Muribaculaceae</i>	3.20±2.08	1.46±1.18	0.71±0.24	1.16±0.80	0.36±0.17	0.590
<i>Peptoclostridium</i>	7.96±1.73	8.43±1.77	7.00±1.26	7.09±0.76	6.93±1.55	0.631
<i>Prevotella</i>	1.43±1.18	0.59±0.28	0.22±0.08	0.84±0.33	0.69±0.42	0.732
<i>Romboutsia</i>	3.72±0.63	2.40±0.46	3.47±0.68	2.15±0.31	3.15±0.78	0.250
<i>Ruminococcus_gnavus_group</i>	0.38±0.07	0.61±0.12	0.49±0.06	0.58±0.06	0.58±0.10	0.229
<i>Streptococcus</i>	4.27±1.32	2.83±1.65	2.94±1.02	6.25±3.33	2.85±0.93	0.217
<i>Turicibacter</i>	10.6±2.51 ^b	4.44±0.96 ^a	5.39±1.28 ^{ab}	6.14±1.48 ^{ab}	4.82±1.49 ^a	0.042

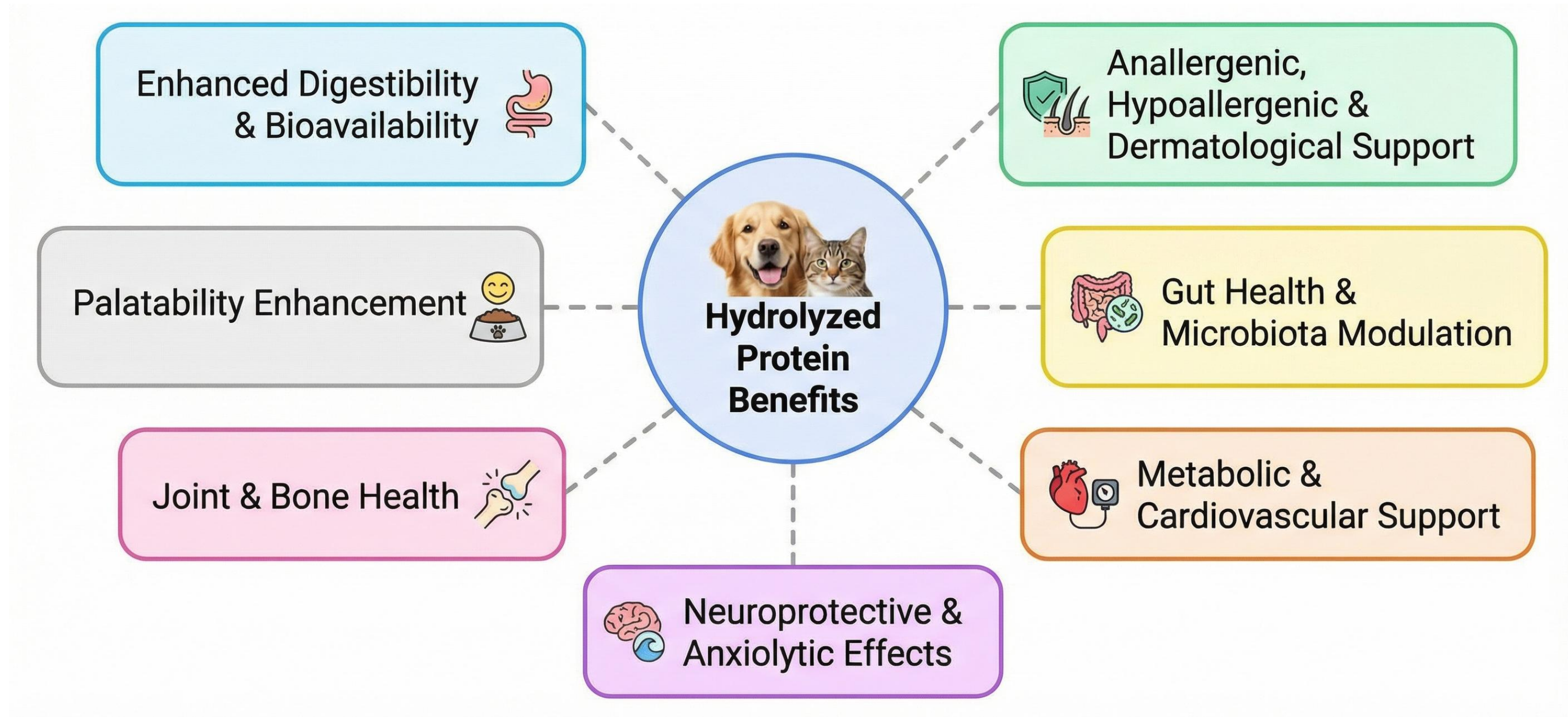
2. Insect proteins: Protein hydrolysates from *Tenebrio molitor* and *Hermetia illucens*



- 3% Supplements
- NS:
 - Palatability, Healthy, Body weight, BCS
 - Fecal consistency, Fecal pH, Fecal ammonia, Total fecal SCFA
 - Digestibility



3. Hydrolysate proteins



Bhati, D., & Hayes, M. (2025). From Ocean to Market: Technical Applications of Fish Protein Hydrolysates in Human Functional Food, Pet Wellness, Aquaculture and Agricultural Bio-Stimulant Product Sectors. *Applied Sciences*, 15(10), 5769.
Oba, P. M., De La Guardia Hidrogo, V. M., Kelly, J., Saunders-Blades, J., Steelman, A. J., & Swanson, K. S. (2024). Effects of diets supplemented with bioactive peptides on nutrient digestibility, immune cell responsiveness, and fecal characteristics, microbiota, and metabolites of adult cats. *Journal of animal science*, 102, skae104.
Ribeiro, T. B., Maia, M. R., Fonseca, A. J., Marques, B., Caleja, C., Rosa, A., ... & Pintado, M. (2025). A comprehensive review of fish protein hydrolysates targeting pet food formulations. *Food Reviews International*, 41(5), 1321-1359.
Vasconcellos, R. S., Volpato, J. A., & Silva, I. C. (2024). Bioactive peptides extracted from hydrolyzed animal byproducts for dogs and cats. *Animal Frontiers*, 14(3), 38-45.

3. Hydrolysate proteins: Hydrolyzed chicken liver



ANIMALS AND HOUSING

12 Healthy Adult Beagles (6M, 6F)
 Age: 5 Years
 Weight: 11.8 ± 1.45 kg
 Body Condition Score: 5-6 / 9

Fed Inside Cages, Socialized Outside

24°C Temp Control
 14:10 h Light:Dark Cycle

Individual Stainless Steel Metabolic Cage

Fed Inside Cages, Socialized Outside

Fed Inside Cages, Socialized Outside

Water Ad Libitum

Socializing Outdoors during Daytime

EXPERIMENTAL DESIGN & DIETS

WASH-IN PERIOD (30 Days):
 ALL dogs fed Identical Commercial Diet (GIT Stabilization)

TREATMENT PERIOD (45 Days):
 Randomized Design, 6 dogs per diet

CONTROL DIET:
 Poultry By-product Meal + Bovine Meat & Bone Meal

HCLP DIET:
 Hydrolyzed Chicken Liver Powder

Food amount adjusted weekly for maintenance energy

SAMPLE COLLECTION AND ANALYSIS

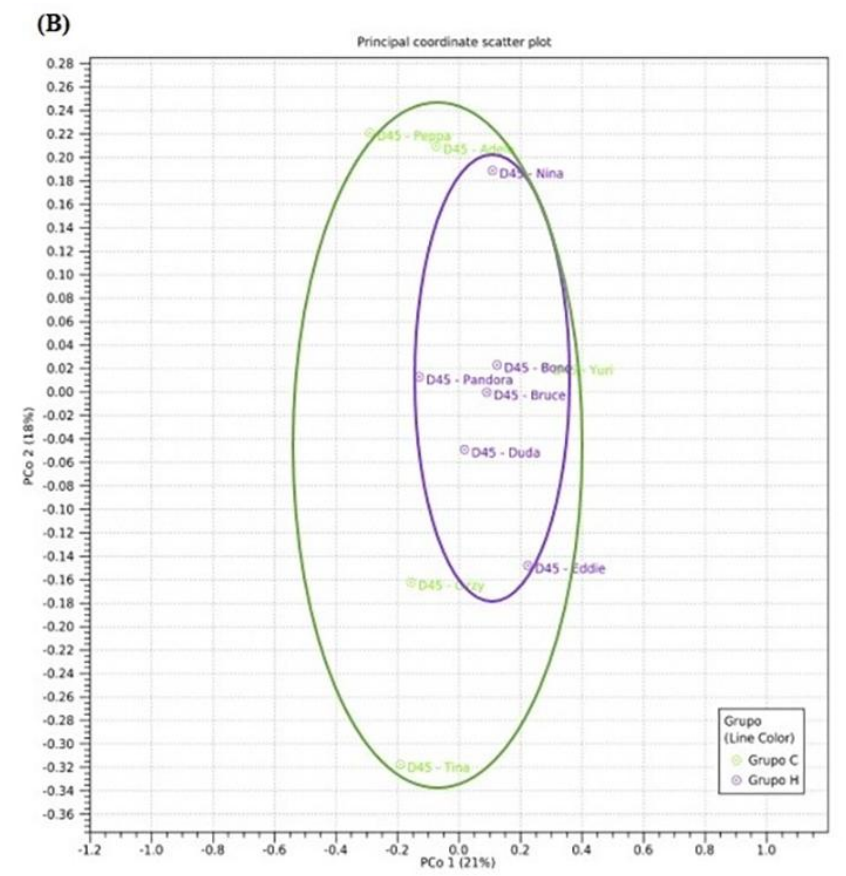
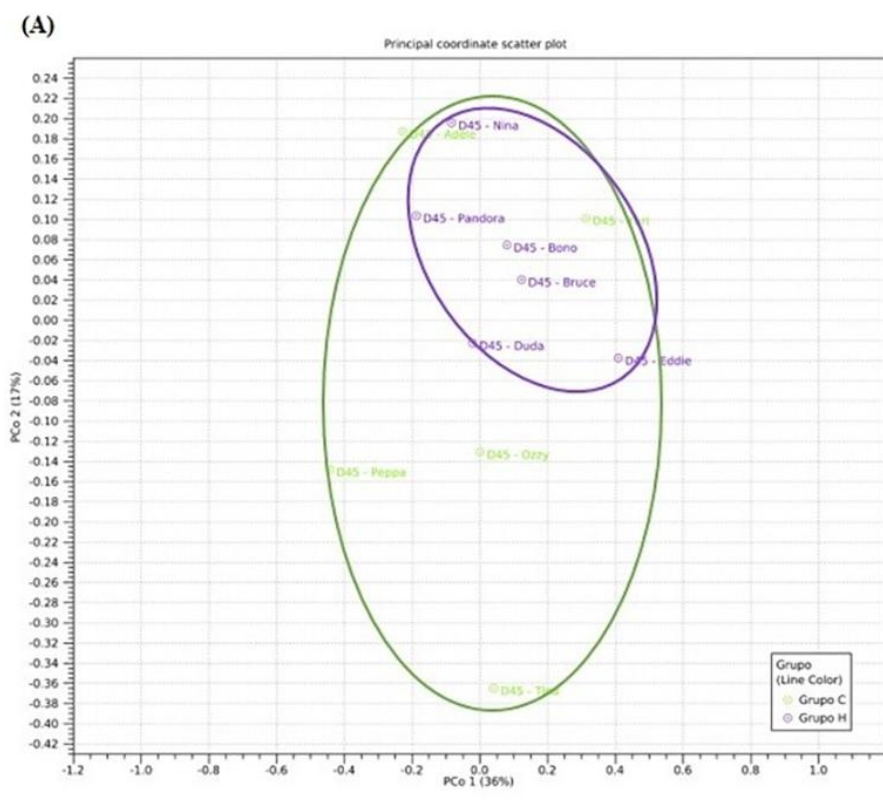
BLOOD SAMPLES

- Jugular Venipuncture
- Before morning feeding
- Days 0, 15, 30, 45
- CBC (Complete Blood Counts)
- Plasma Cytokines
- Immunoglobulins

FECAL SAMPLES

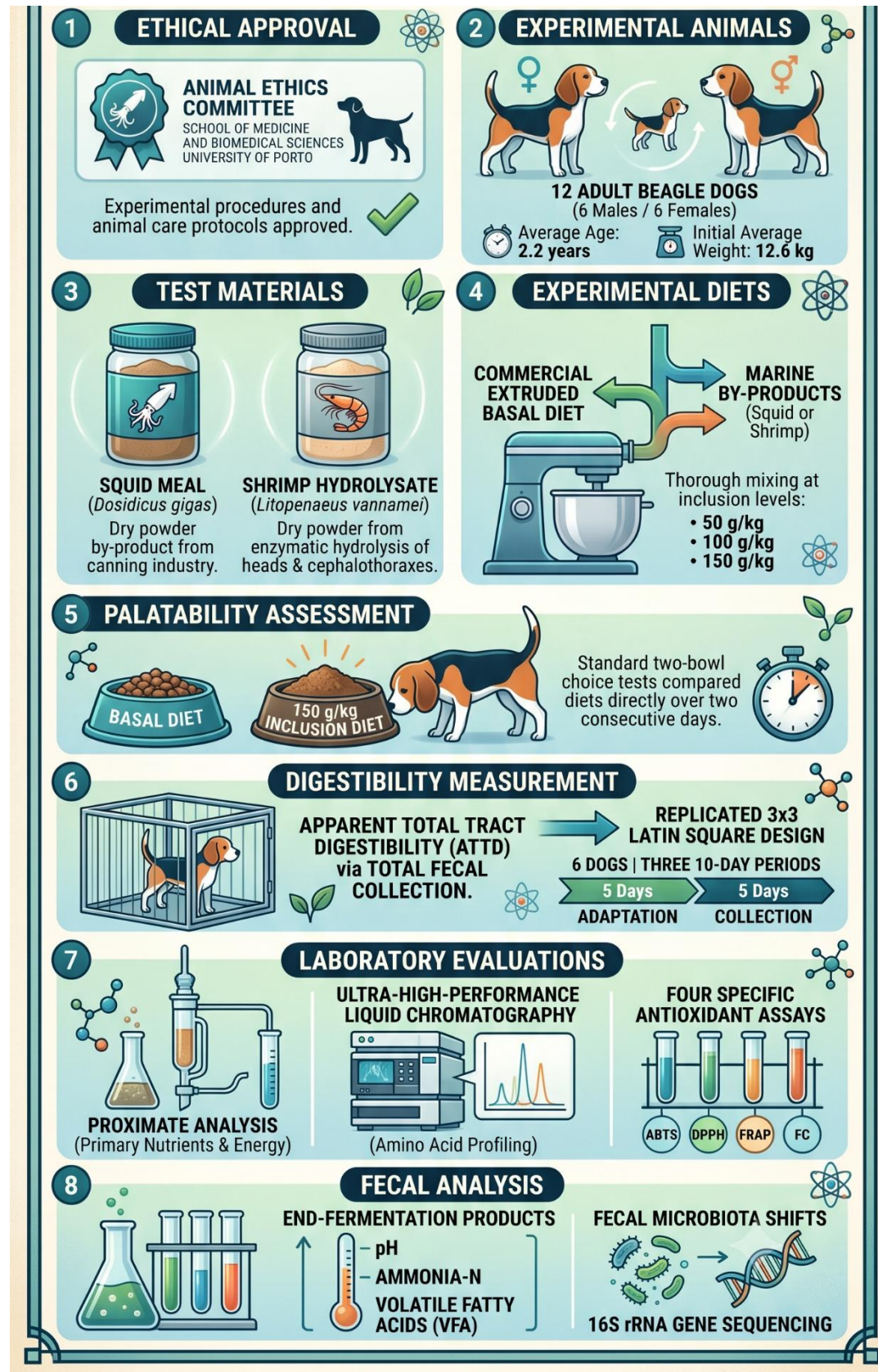
- Morning of Day 45
- Analyzed for:
 - Total DNA Extraction
 - Amplified V3V4 region of 16S rRNA gene
 - Metagenomic Sequencing

- 100% Replacement
- NS: Hematology, Blood chemistry, IgE, IFN-γ, TNF-α, IL-2, or IL-10, Fecal microbiota
- Control group
 - **Decrease** of plasma IgA
- Hydrolyzed chicken liver group
 - **Decrease** of Eosinophils
 - Exhibited a distinct clustering effect



Principal Coordinate Analysis (PCoA) plots of Bray-Curtis (A) and D_0.5 UniFrac (B) distances of fecal samples. Treatments are represented as: Control in green, and HCLP in purple. Control, poultry by-product + bovine meat and bone meals-based diet; HCLP, hydrolyzed chicken liver powder-based diet.

3. Hydrolysate proteins: Squid meal and shrimp hydrolysate



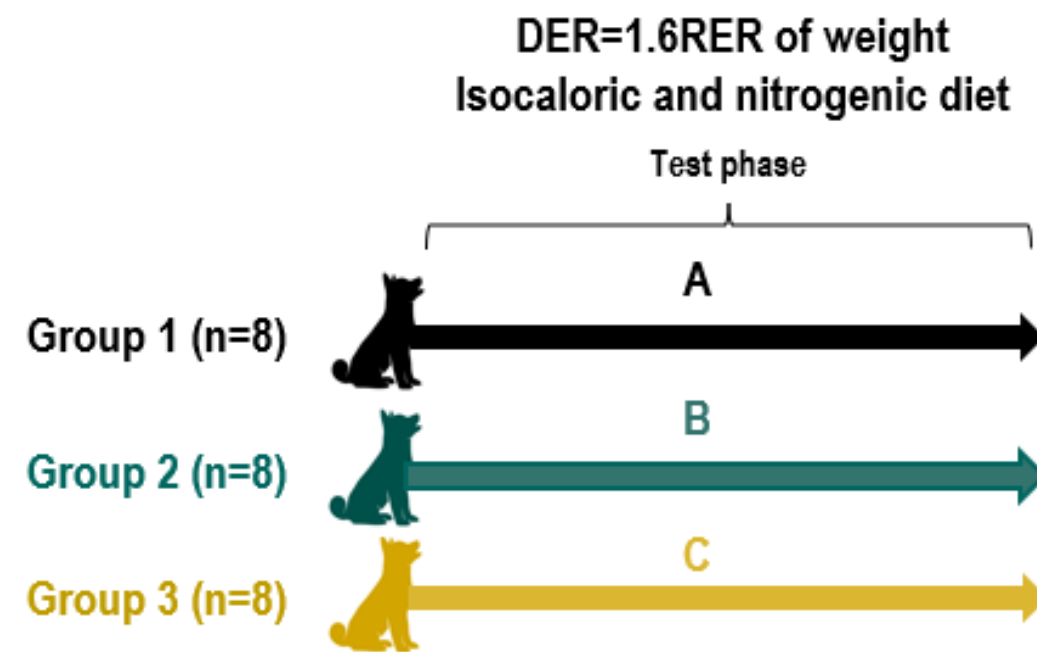
- Marine by-products provides a circular economy strategy
 - with antioxidant properties (Shrimp > Squid meal)
- 5, 10 and 15% Replacement
- NS: Palatability & Fecal characteristic
- Squid and shrimp hydrolysate
 - **Increase** digestibility
- Squid hydrolysate
 - **Increase** fecal ammonia
 - **Decrease** fecal butyrate
 - None effects on fecal microbiota
- Shrimp hydrolysate
 - **Increase** total fecal VFA production except butyrate
 - **Decrease** *Firmicutes* and *Lactobacillus*
 - **Increase** *Oscillospiraceae* (UCG-005)

	Shrimp meal		
	i05	i10	i15
Oscillospiraceae (UCG-005)			1.6
Lactobacillus		-1.8	
Firmicutes	-2.3		

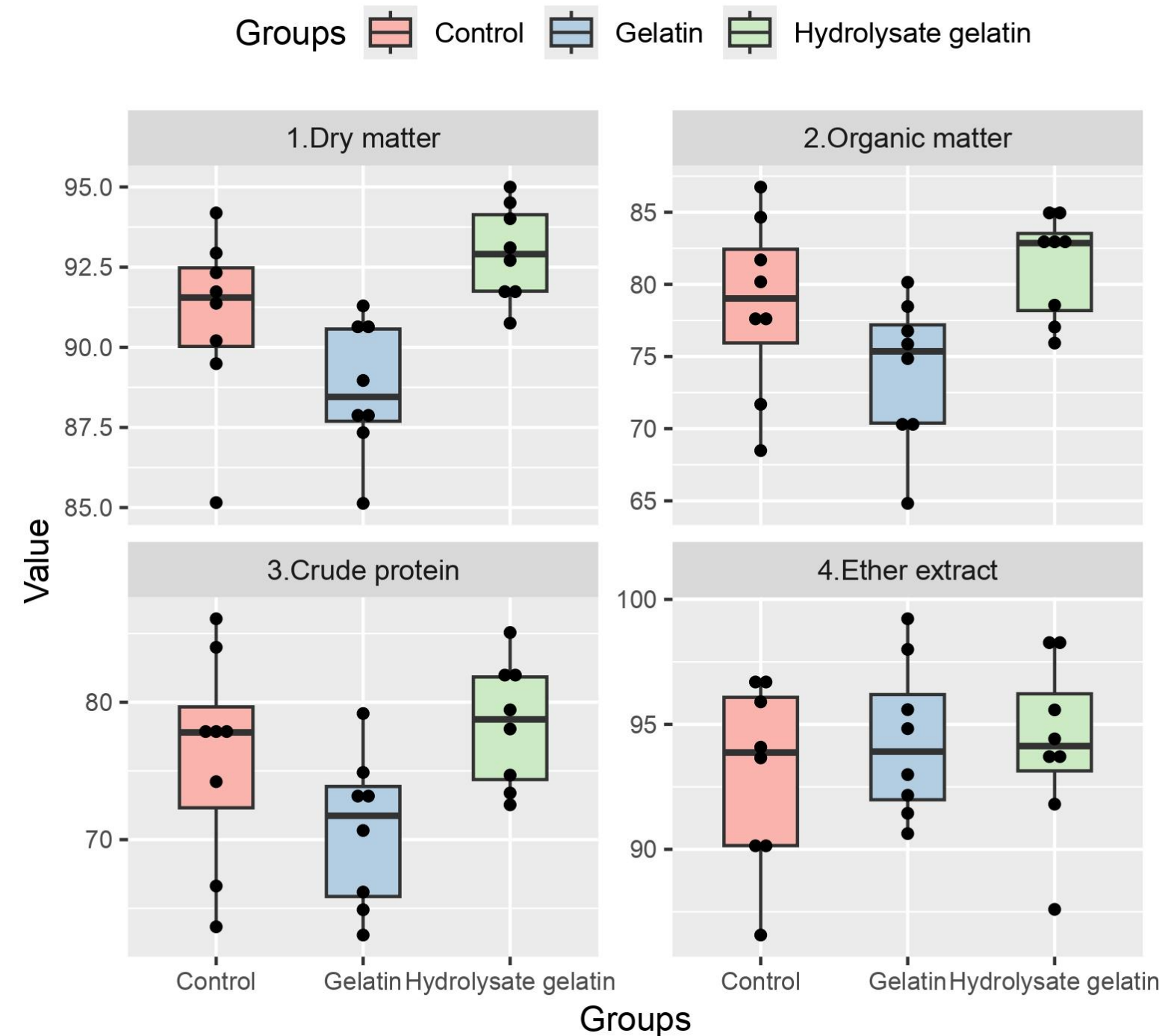
Effect size



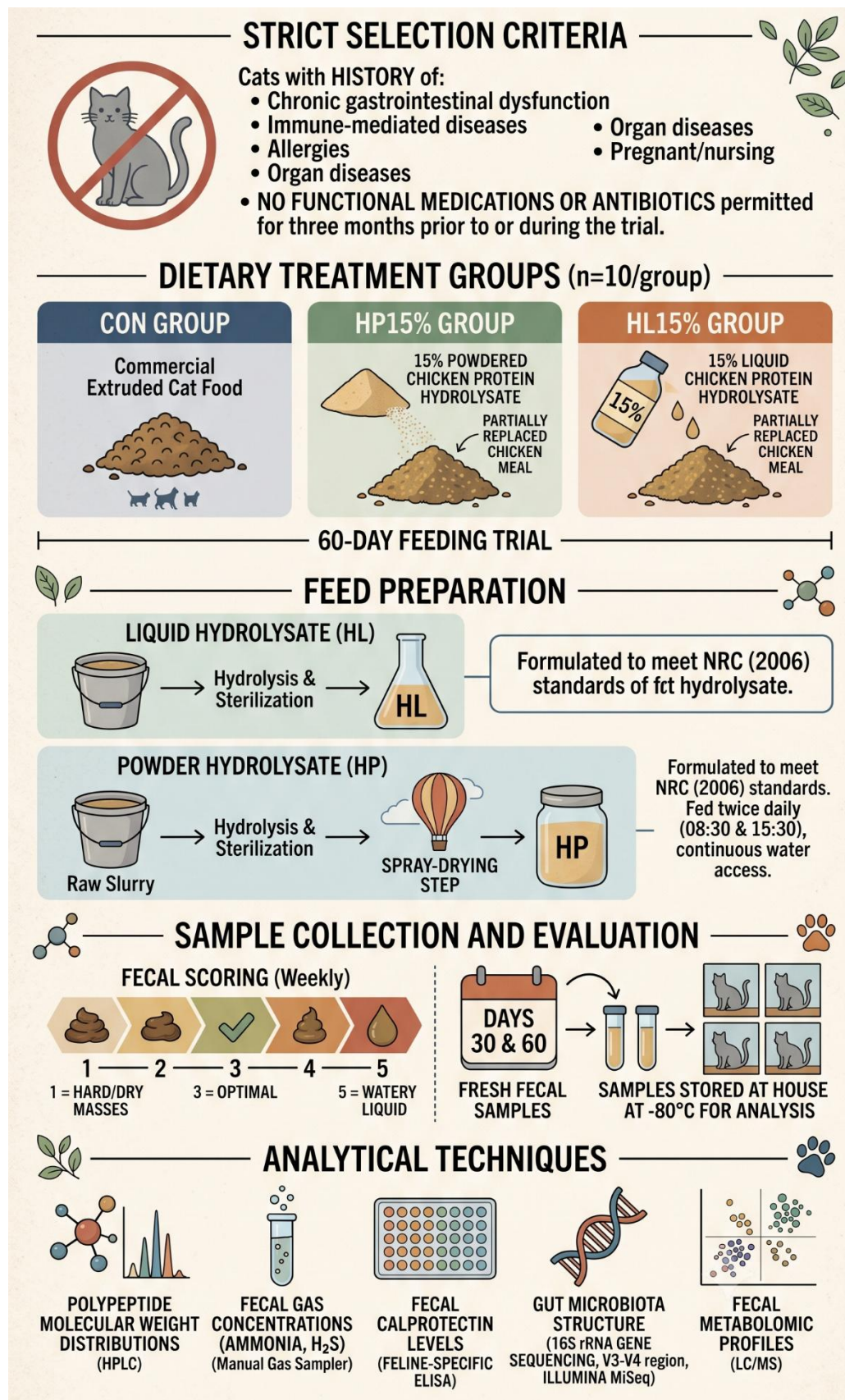
3. Hydrolysate proteins: Gelatin by-products



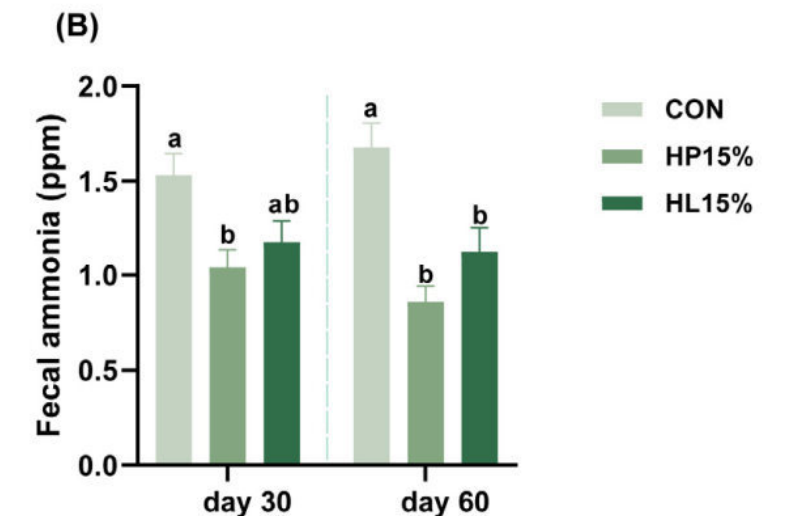
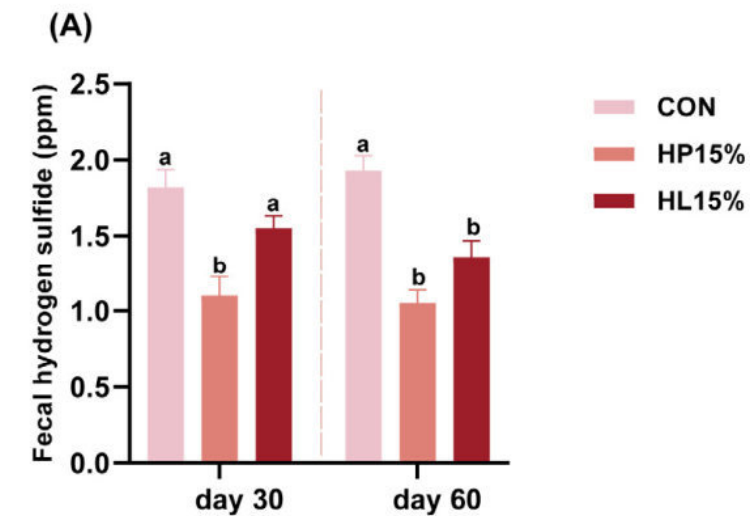
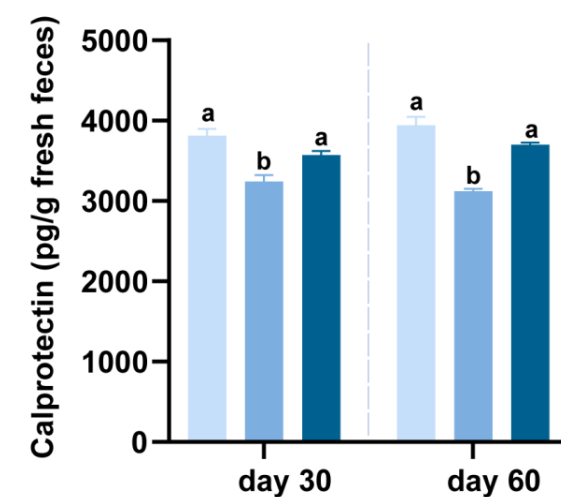
- Gelatin is a by-product of the pharmaceutical and leather industries.
- Up to 8% hydrolyzed gelatin can be incorporated into canine diets without adverse effects on blood parameters or gut microbiota.
- Regular gelatin is not suitable due to its lower digestibility.



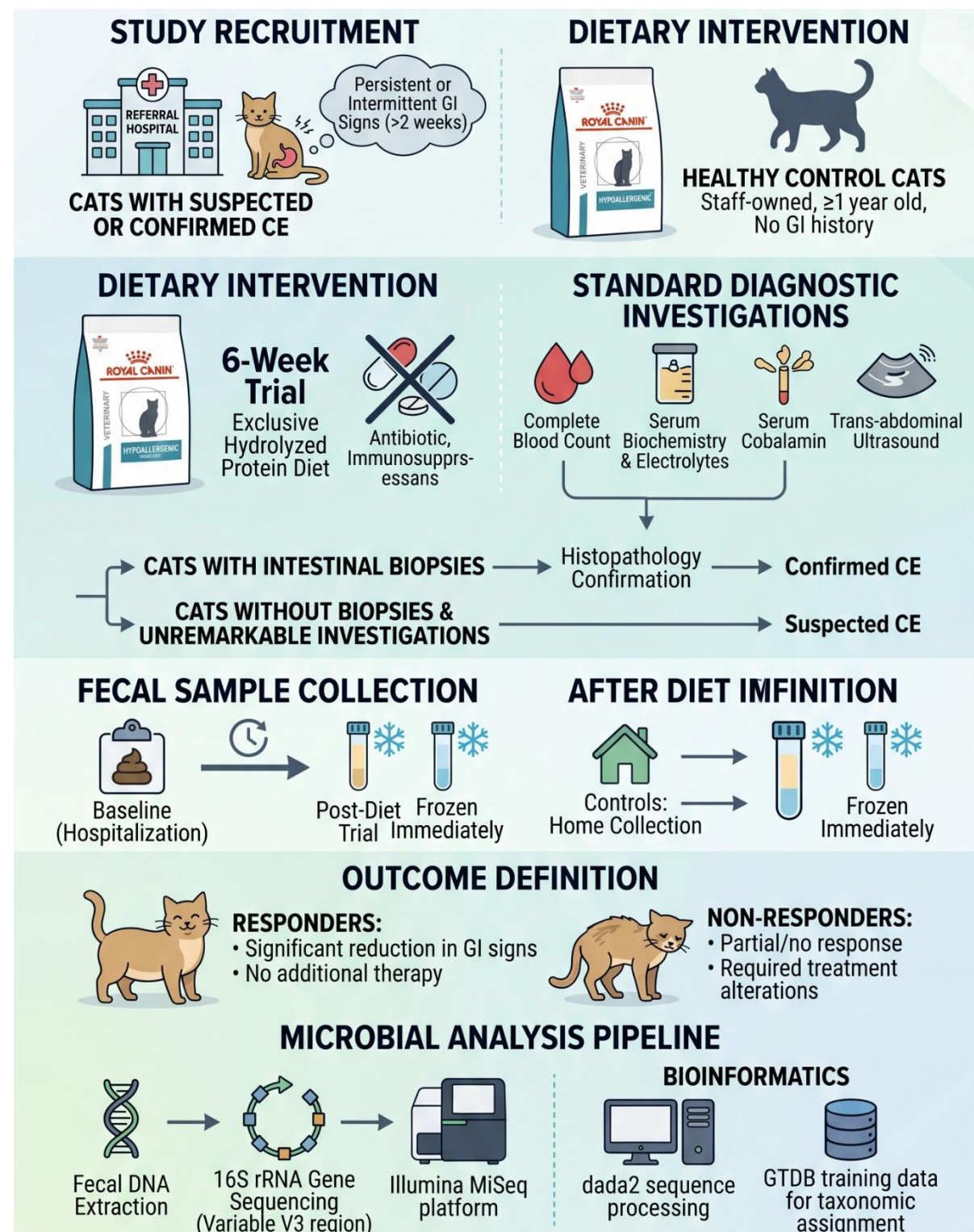
3. Hydrolysate proteins: Chicken protein hydrolysate in cats



- 60 days studies: Replacing the chicken meals at 15%
- NS: Fecal score, Fecal bacterial microbiota
- Hydrolyzed powder
 - Increase *Bacteroides* spp. and *Bifidobacterium* spp.
 - Decrease fecal calprotectin, fecal odor
- Hydrolyzed liquid
 - Increase *Bacteroides* spp. and *Bifidobacterium* spp.
 - Decrease fecal calprotectin, fecal odor



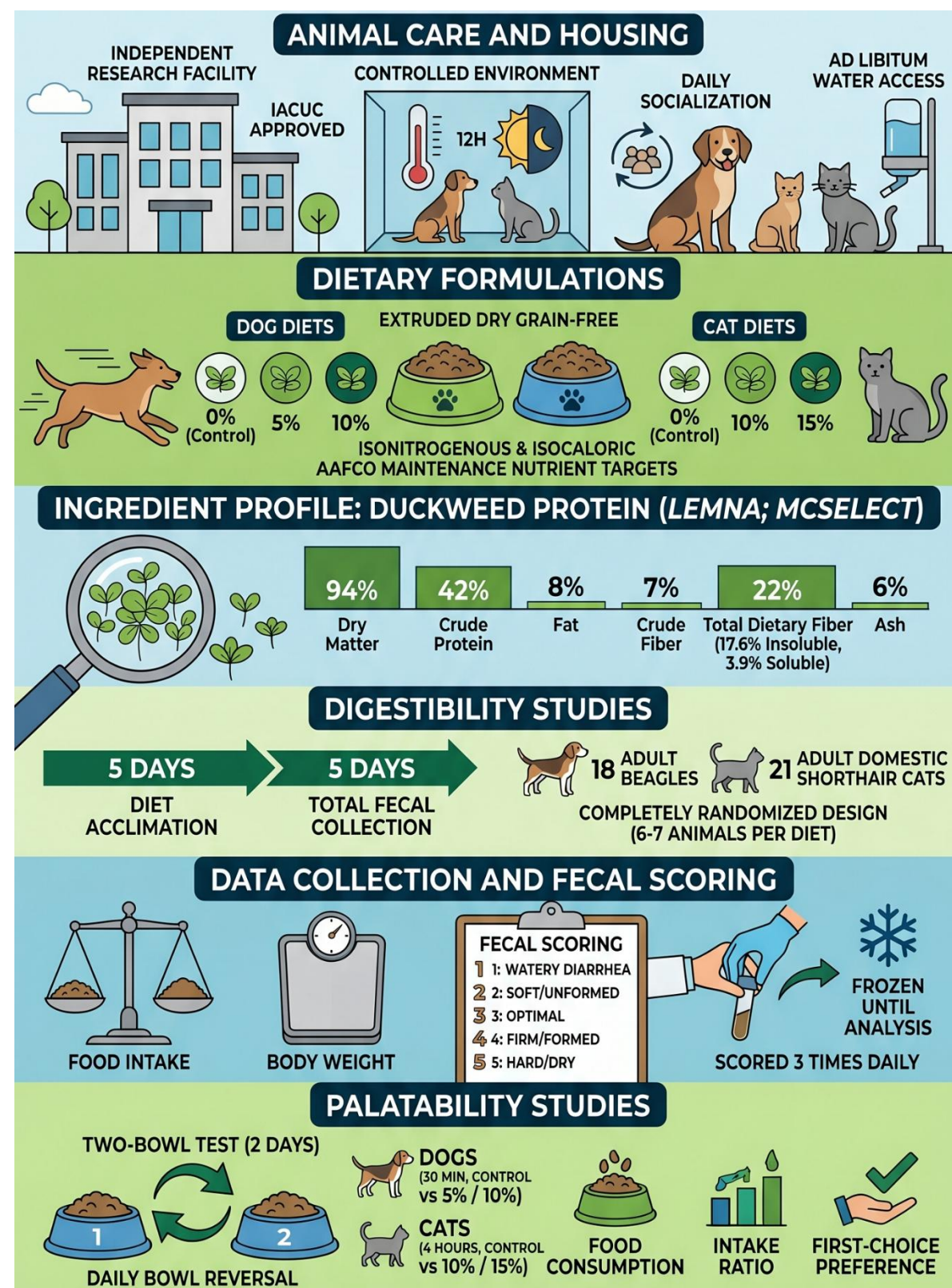
3. Hydrolysate proteins: Feline chronic enteropathy cats



- Feline chronic enteropathy comprises a spectrum of idiopathic diseases that cause chronic gastrointestinal signs
- 36 cats with CE and 14 healthy control cats
- 15 cats (45%) were responders and 18 cats (55%) were non-responders.
- Cats with CE
 - Increase *Clostridium* sp.
 - Decrease alpha-diversity
- Hydrolysate protein groups
 - Decrease of abundance of most fecal bacteria
 - e.g., *Oscillibacter*, *Sutterella* and *Fusobacterium*).



3. Aquatic plants: Duckweed (Lemnaceae)

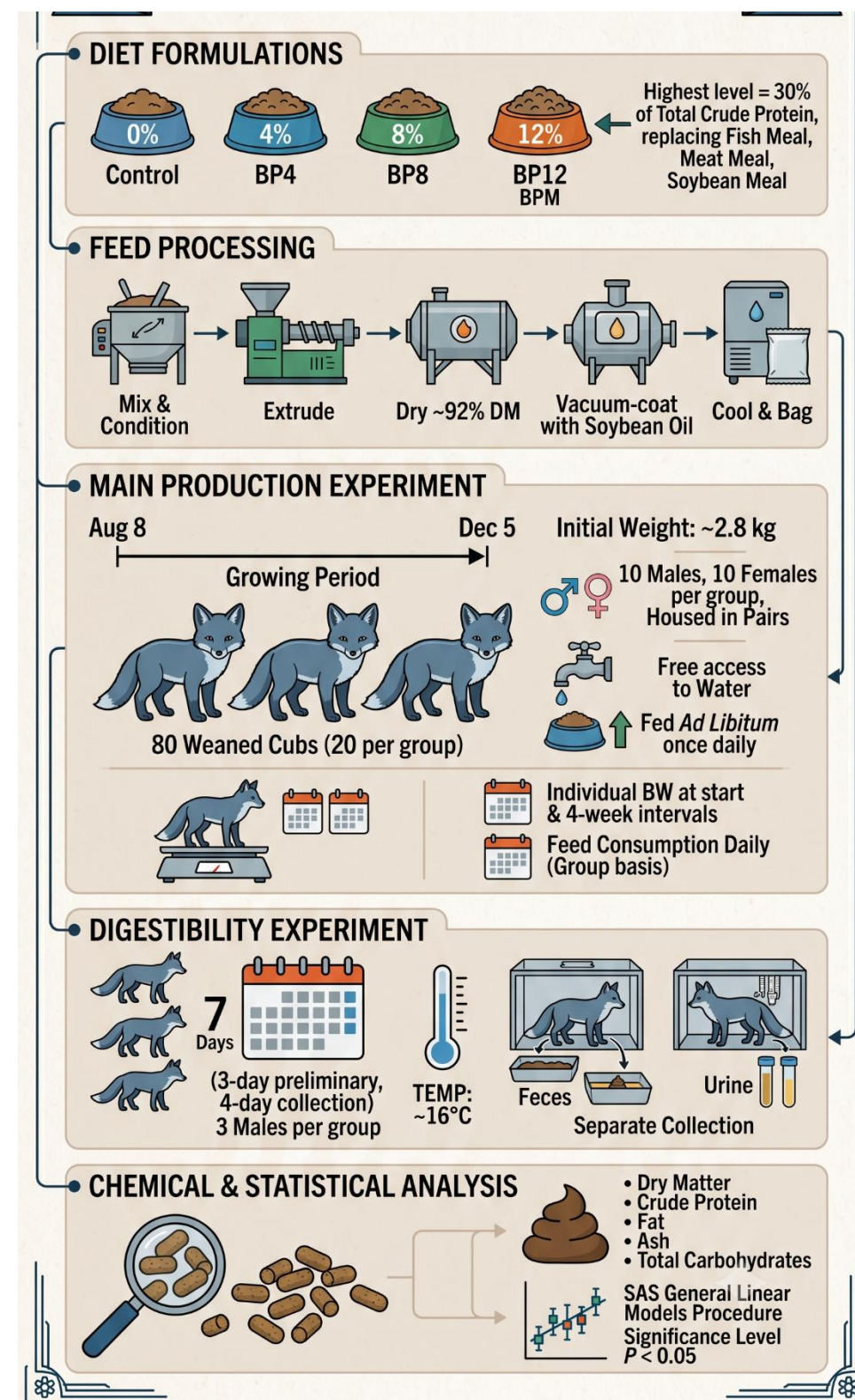


- 0, 10 and 15% in extruded dry grain-free diet in dogs and cats
- Duckweed groups (Dogs)
 - NS: BW, Feed intake, Digestibility, Fecal moisture
 - Increase firm of feces
 - Decrease Palatability (Intake ratio, daily intake and first bite)
- Duckweed groups (Cats)
 - NS: BW
 - Increase Feed intake, Fecal output
 - Decrease Digestibility, Palatability (Intake ratio, daily intake and first bite)

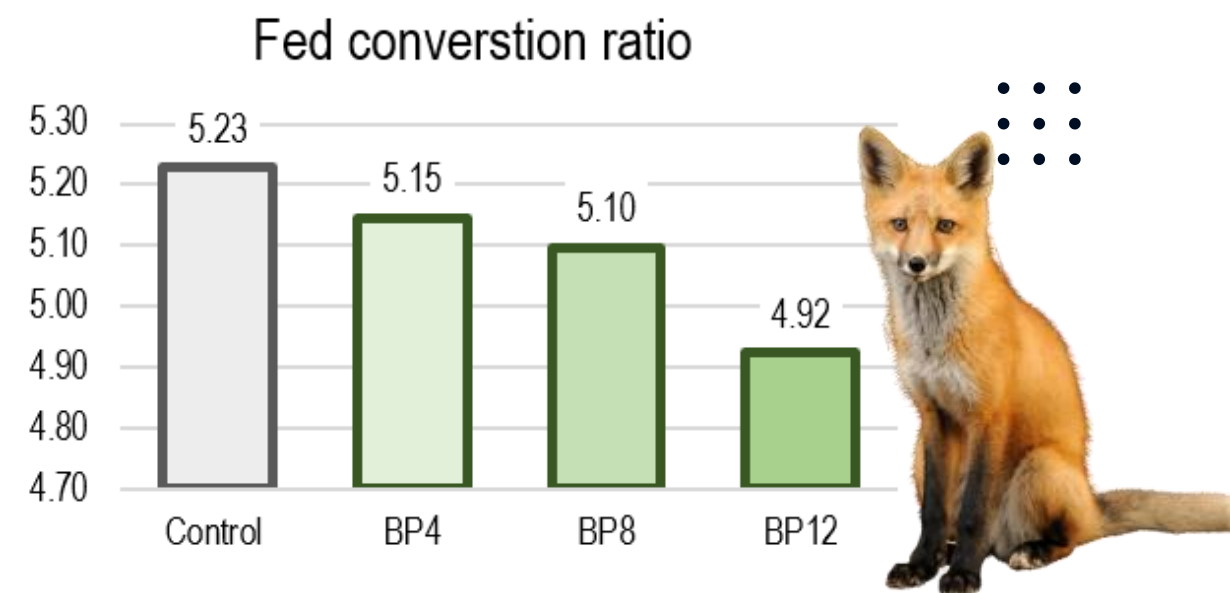


Figure 1. Fecal samples from dogs consuming dry diets with duckweed displayed greenish color. (A) Control diet, (B) 5% duckweed diet, and (C) 10% duckweed diet.

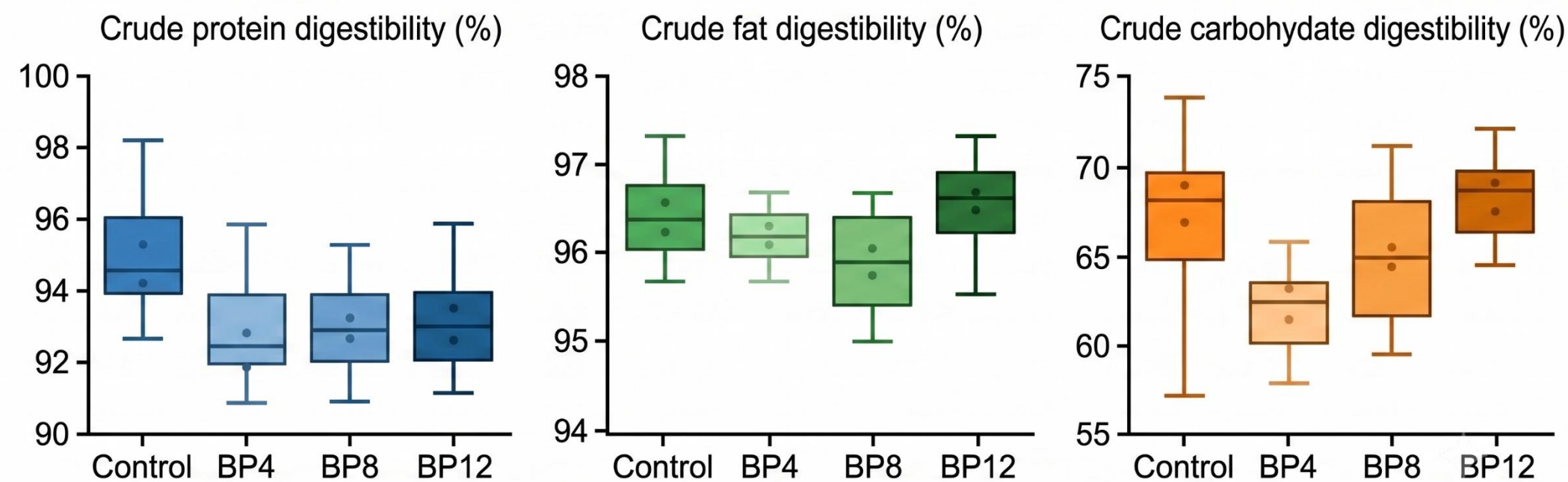
4. Single cell protein: Bacteria protein meal in blue fox



- Mixtures of
 - Methylococcus capsulatus* (Bath)
 - Alcaligenes acidovorans*
 - Bacillus brevis*
 - Bacillus firmus*
- Replacing Fishmeal, Soybean meal and Meat meal (4-month trials)
- BPM level did not impact palatability, feed intake, digestibility, body weight and fur quality.
- BPM decrease FCR than control diets.

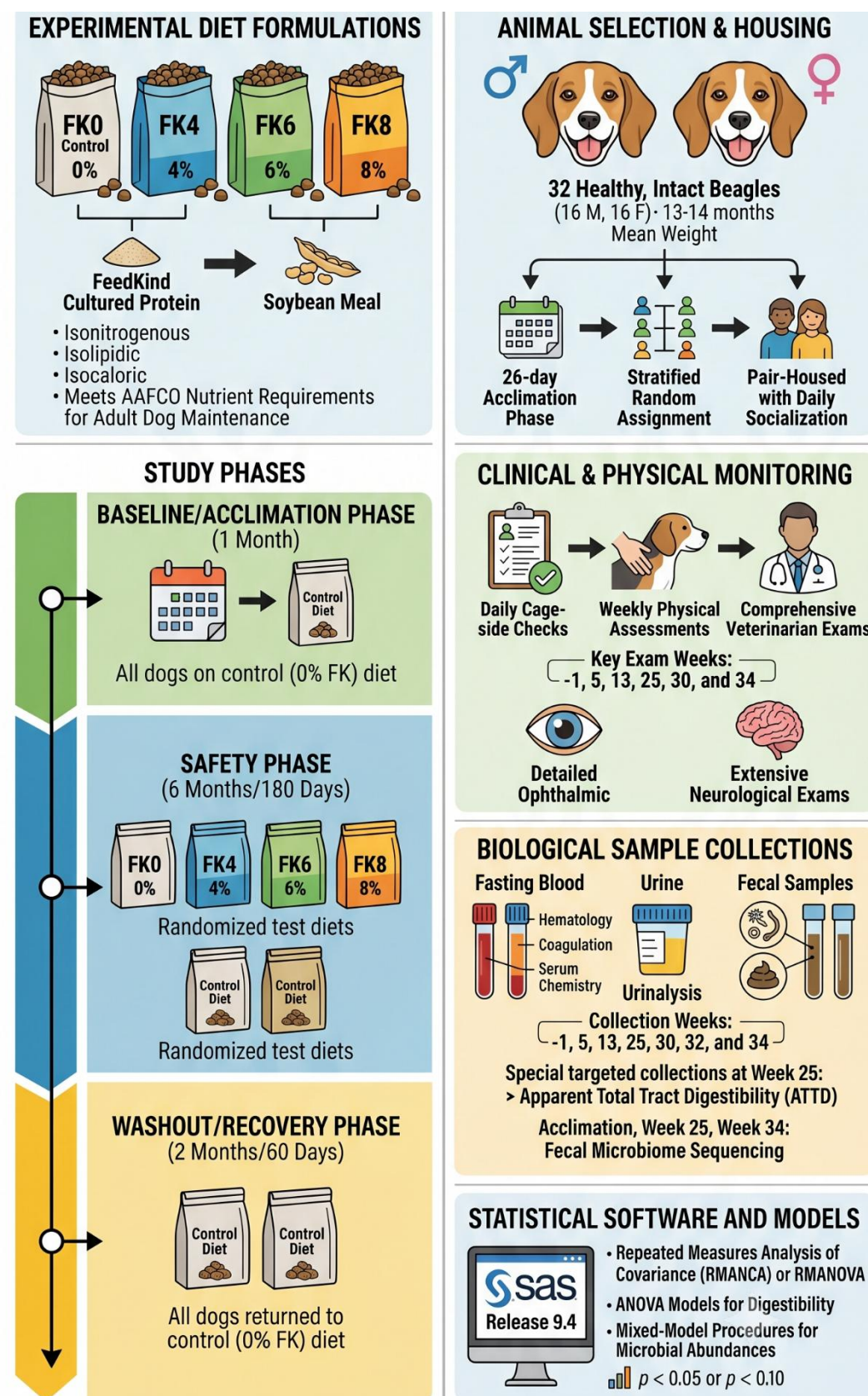


Average digestibility of main nutrients (%) in experiment with different levels of BPM¹



¹ Standard deviations are in parentheses. There were three foxes per diet group. There were no significant differences among the diets.

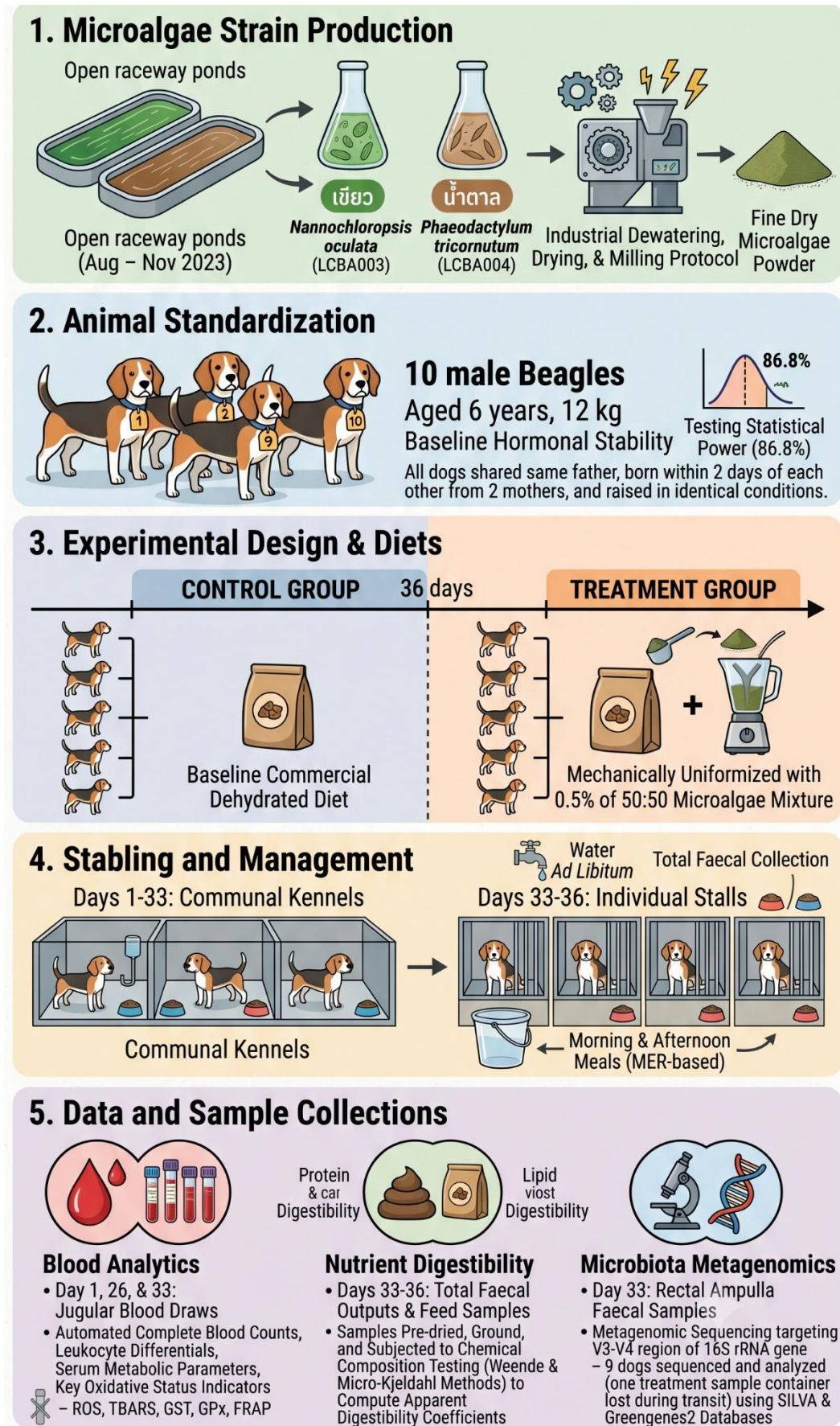
4. Single cell protein: Bacteria protein (*Methylococcus capsulatus*)



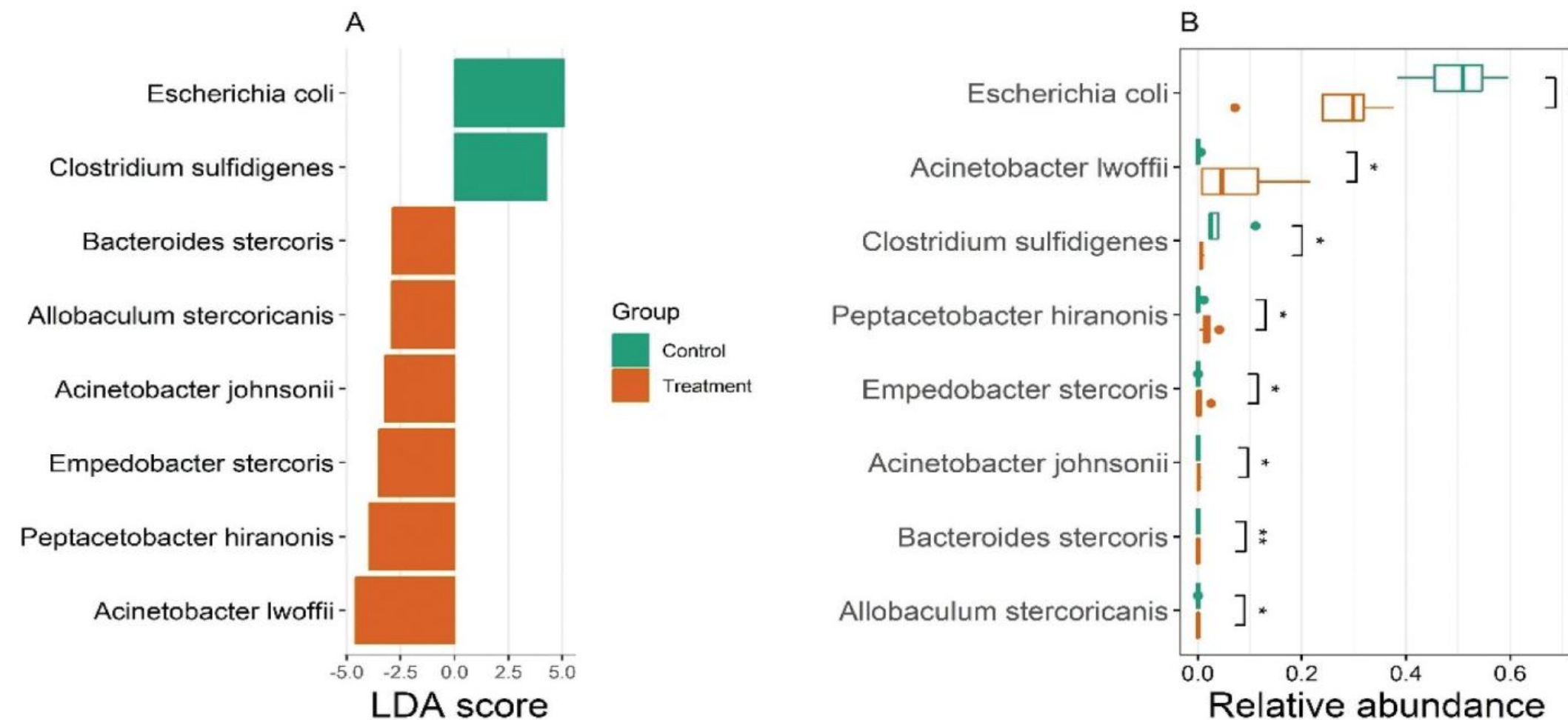
- *Methylococcus capsulatus* (Bath) used Methane as substrate
- Replacing Soybean meal and Chicken meal
- NS: Feed intake, BW, BCS, Blood parameter, Urinalysis
- Digestibility are higher than 80%
- None major change on bacterial microbiota.



4. Single cell protein: Microalgae (*Phaeodactylum tricornutum* & *Nannochloropsis oculata*)

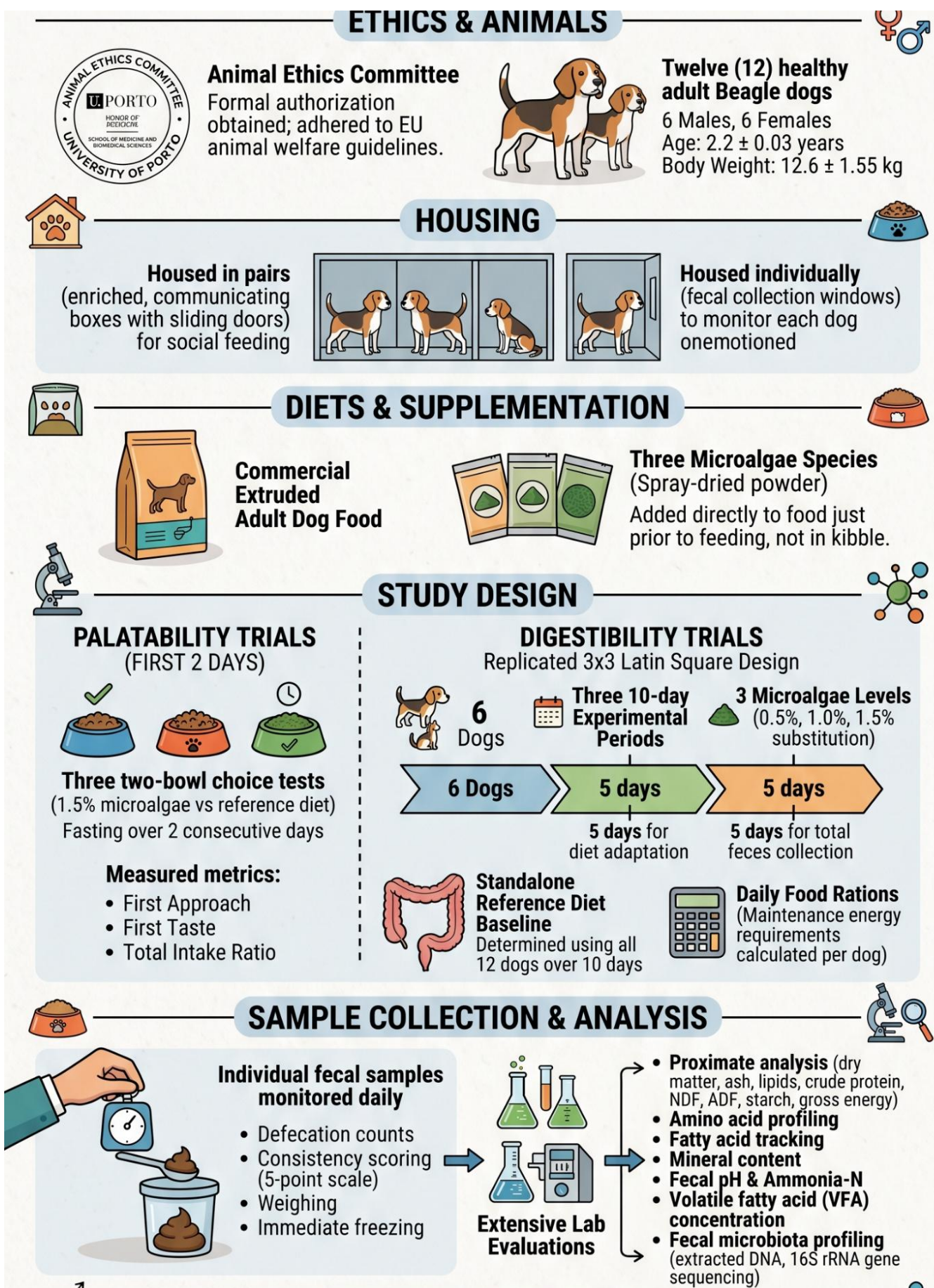


- Source of Omega 3 (EPA) & Antioxidants
- 0.5% Supplementation in diets
- NS: Digestibility, Blood parameters, Health
- Supplemented groups
 - Higher total white blood cells, Cholesterol and HDL
 - Higher TBARs and cellular ROS
 - Minor changed bacterial microbiota

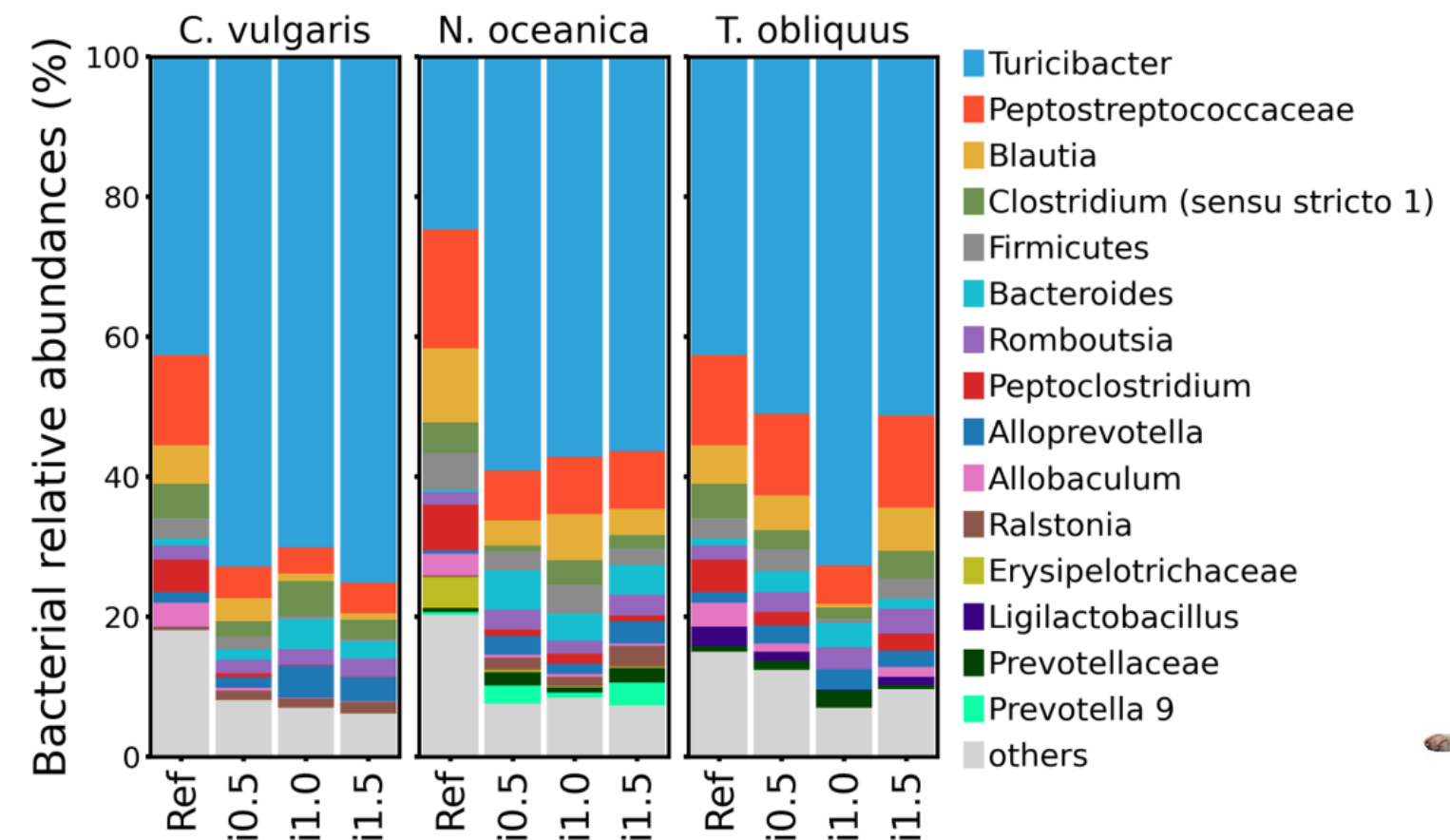


Ramos, P. D., da Silva, A. S., Boff, V. G., Giorgio de Oliveira Cécere, B., Bajay, M. M., De Oliveira Jaime Sales, R., ... & Baretta, D. (2026). Combination of microalgae *Phaeodactylum tricornutum* and *Nannochloropsis oculata* in the diet of dogs and its impact on animal health. *Applied Phycology*, 7(1), 2632648. [tandfonline.com/doi/abs/10.1080/26388081.2026.2632648](https://doi.org/10.1080/26388081.2026.2632648)

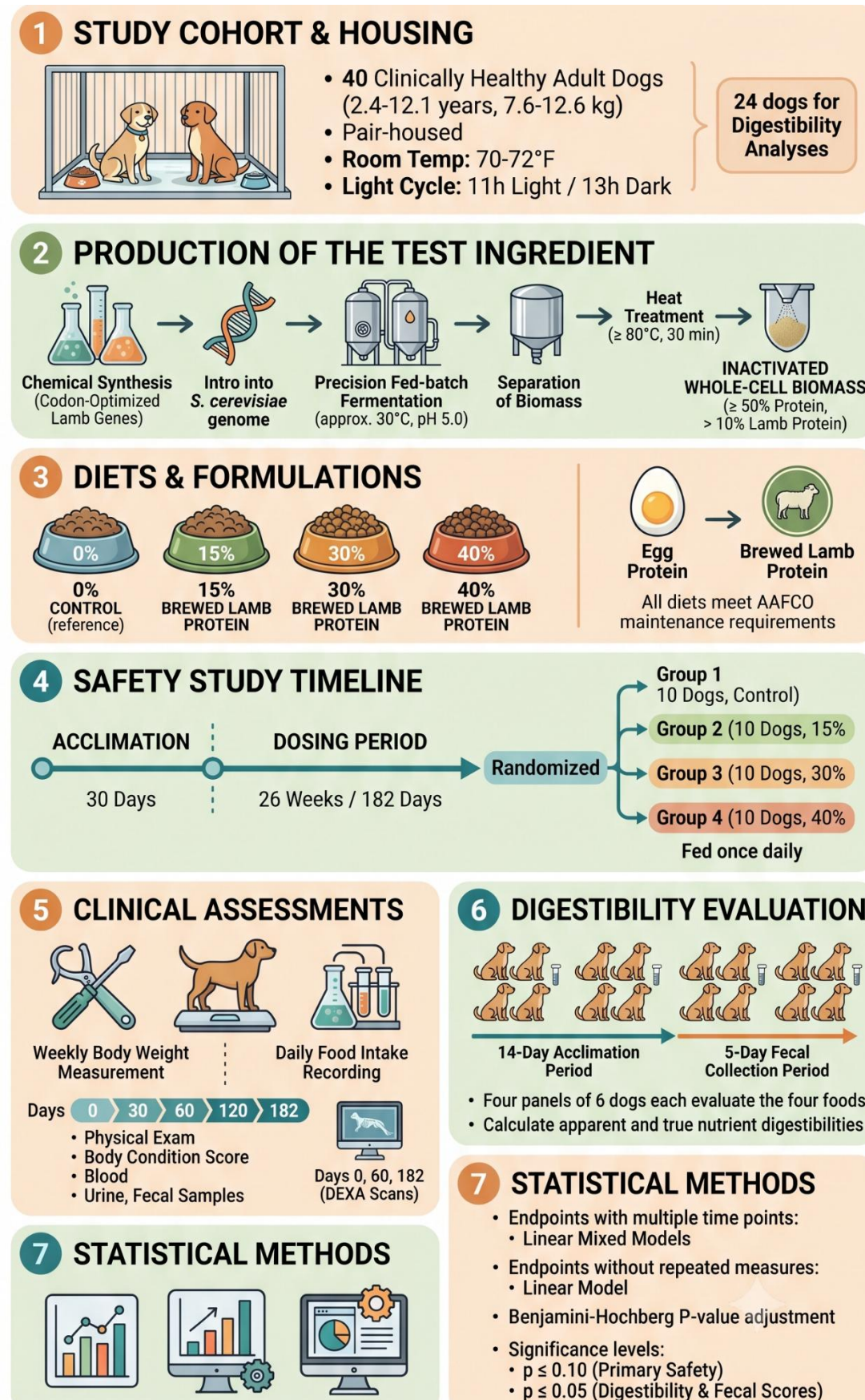
4. Single cell protein: Microalgae (*Chlorella vulgaris*, *Nannochloropsis oceanica* and *Tetradesmus obliquus*)



- 0.5, 1 and 1.5% Supplementation in diets
- NS: Palatability, Health, Feed intake, Digestibility
- *Chlorella vulgaris*
 - **Increase** digestibility of crude protein, total fecal VFA (fecal acetate, propionate, butyrate, iso-butyrate, iso valerate)
 - **Decrease** fecal amount, fecal pH,
- *Nannochloropsis oceanica*
 - **Increase** total fecal VFA (acetate, propionate, butyrate, iso-butyrate, iso valerate)
 - **Decrease** fecal pH,
- *Tetradesmus obliquus*
 - **Increase** total fecal VFA (acetate)
 - **Decrease** fecal amount & fecal pH



5. Fermented protein (Acellular products): *Saccharomyces cerevisiae* expressing a lamb protein



- Replacing egg protein
- NS: Health, Blood parameters, Urinary analysis
- Test groups
 - Lower in blood Taurine but in normal range.
 - Higher in ALT (liver damage enzyme) but in normal range.
 - Lower amount of fecal output
 - Higher apparent digestibility on dry matter
 - Lower apparent digestibility on fat
 - Lower fecal pH: Colonic fermentation from higher insoluble fiber?

French, S., Cochrane, C. Y., Faurot, M., Audibert, P., Belloso, T., & Badri, D. V. (2025). Safety and digestibility of a novel ingredient, brewed lamb protein, in healthy adult dogs. *Animals*, 15(3), 427. <https://www.mdpi.com/2076-2615/15/3/427>

6. Cultured meat



- **Production & Method**

- Cultured meat is grown *in vitro* using isolated animal cells (from mammals, birds, or fish) structured to mimic traditional meat cuts.

- **Health & Sustainability Benefits**

- It provides significant environmental and animal welfare advantages.
- Furthermore, it eliminates harmful substances

- **Regulatory & Market Landscape**

- Only a few regions have authorized cultured meat for human consumption, with Singapore leading the market, followed by the United States and the Middle East.

Challenges of novel protein in pet industry



1. Consumer Acceptance and Perception

- Food neophobia

2. Food Safety and Allergenicity

- Contamination & Cross-reactive allergic reactions

3. Technological Scaling and Efficiency

- Substantial investments and technical breakthroughs in biotechnology and bioreactor designs are required to lower production costs for cell-based and fermentation-derived proteins.

4. Regulatory Disparities

- Lack of internationally harmonized testing standards

Conclusion



Protein sources	Safety (Contamination)	Palatability	Digestibility	Nutrient Quality	Allergenicity	Sustainability
Animal by-products (Organs, Feather)	Pathogen, Chemical	High	High	High	Moderate	High
Meat (Chicken, Beef, Lamb, Rabbit, Crocodile)	Pathogen, Chemical	High	High	High	Moderate	Low
Fish (Salmon, Tuna, Tilapia)	Pathogen, Heavy metal	High	High	High	Low	Low
Plant-based (Soy, Pea, Wheat, Gluten)	Chemical	Low	Moderate	Low (Low methionine)	Low	High
Hydrolyzed protein (Animal or Plant)	-	High	Very High	High	Very Low or None	High (from by-products)
Insect-based (BSF, Cricket, Mealworm)	Heavy metal	Moderate	Moderate	Moderate	Low	Very High
Mycoprotein (Fungi) Single-cell (Yeast, Algae, Bacteria)	Nucleotide	Depends species and levels	High	Depends on species (Low Methionine)	?	Very High
Cultured meat	Sterile	?	High	High	?	Very High
Other novel proteins	?	?	?	?	?	?



References

- Abdelhady, H. A., Yassin, A. M., Aboul-Ella, H., Fahmy, K. N. E., Farghali, H. A. M., & Tony, M. A. (2026). Integrated effects of dietary supplementation of *Spirulina platensis* in working dogs: Nutritional, biochemical, antioxidant, immunological, gut-related microbial and nutrigenomic insights. *BMC Veterinary Research*, 22, 271. <https://doi.org/10.1186/s12917-026-05498-5>
- Blue Buffalo Co., Ltd. (2026). Canine NP Novel Protein–Alligator. Blue Vet Connect.
- Bosch, G., Zhang, S., Oonincx, D. G. A. B., & Hendriks, W. H. (2014). Protein quality of insects as potential ingredients for dog and cat foods. *Journal of Nutritional Science*, 3, e29. <https://doi.org/10.1017/jns.2014.23>
- Brassó, L. D., Szabó, V., Komlósi, I., Pusztahelyi, T., & Várszegi, Z. (2021). Preliminary study of slaughter value and meat characteristics of 18 months ostrich reared in Hungary. *Agriculture*, 11(9), 885. <https://doi.org/10.3390/agriculture11090885>
- Cabrita, A. R. J., Guilherme-Fernandes, J., Spínola, M., Maia, M. R. G., Yergaliyev, T., Camarinha-Silva, A., & Fonseca, A. J. M. (2023). Effects of microalgae as dietary supplement on palatability, digestibility, fecal metabolites, and microbiota in healthy dogs. *Frontiers in Veterinary Science*, 10, 1245790. <https://doi.org/10.3389/fvets.2023.1245790>
- Carrillo-Huerta, Y. D., Gutiérrez-Chávez, A. J., Pérez-Zavala, M. d. L., Casados-Vázquez, L. E., & Barboza-Corona, J. E. (2025). Alternative proteins: An innovative approach to dog food production. *Frontiers in Animal Science*, 6, 1701677. <https://doi.org/10.3389/fanim.2025.1701677>
- Clinical Nutrition Team. (2017, May 15). Alligator, wild boar, ostrich – oh my! *Petfoodology Blog*, Cummings School of Veterinary Medicine at Tufts University.
- Cosío-Carpintero, K. E., Gutiérrez Olvera, C., Márquez-Mota, C. C., Ortega-Cerrilla, M. E., Sánchez-González, M. G., & Gutiérrez Olvera, L. (2022). High levels of dietary digestible protein transiently promote beneficial bacteria in adult dog feces. *Veterinaria México OA*, 9. <https://doi.org/10.22201/fmvz.24486760e.2022.985>
- French, S., Cochrane, C.-Y., Faurot, M., Audibert, P., Belloso, T., & Badri, D. V. (2025). Safety and digestibility of a novel ingredient, brewed lamb protein, in healthy adult dogs. *Animals*, 15(3), 427. <https://doi.org/10.3390/ani15030427>
- The Grateful Pet. (n.d.). Kangaroo meat: An alternative protein for pets with food allergies. (Note: Alphabetized under "G" per APA guidelines for group authors starting with "The")
- Grishko, V., Tytariova, O., Cherniavskiy, O., Hryhorash, Y., Malyna, V., Balytskyi, Y., Fedorchenko, M., & Bondarenko, L. (2026). The effect of chlorella and spirulina on hematological and biochemical blood parameters of working German shepherd dogs. *Ukrainian Journal of Veterinary and Agricultural Sciences*, 9(1), 88–93. <https://doi.org/10.32718/ujvas9-1.15>
- Guilherme-Fernandes, J., Aires, T., Fonseca, A. J. M., Yergaliyev, T., Camarinha-Silva, A., Lima, S. A. C., Maia, M. R. G., & Cabrita, A. R. J. (2024). Squid meal and shrimp hydrolysate as novel protein sources for dog food. *Frontiers in Veterinary Science*, 11, 1360939. <https://doi.org/10.3389/fvets.2024.1360939>
- Healthy Dog Treats. (n.d.). The importance of kangaroo proteins and amino acid for dogs and see data tables.
- Kathrani, A., et al. (2022). [Title not explicitly listed in excerpt; relates to the effect of a hydrolyzed protein diet on the fecal microbiota in cats with chronic enteropathy]. *Scientific Reports*. <https://doi.org/10.1038/s41598-022-06576-y>
- Klinmalai, P., Kamonpatana, P., Thongpech, A., Sodsai, J., Promhuad, K., Srisa, A., Laorenza, Y., Kovitvadhi, A., Areerat, S., Seubsai, A., Sablani, S. S., & Harnkarnsujarit, N. (2025). Comprehensive review of alternative proteins in pet food: Research publications, patents, and product trends in plant, aquatic, insect, and cell-based sources. *Foods*, 14(15), 2640. <https://doi.org/10.3390/foods14152640>
- Leal, D., Borges, S., Almeida, A., Pintado, M., Fonseca, A. J. M., & Cabrita, A. R. J. (2025). Protein hydrolysates from *Tenebrio molitor* and *Hermetia illucens* as novel food sources for dogs. *Translational Animal Science*, 9, txaf106. <https://doi.org/10.1093/tas/txaf106>
- Lin, C.-Y., Kerr, K. R., Panasevich, M. R., Daristotle, L., & Frantz, N. Z. (2024). Duckweed protein as an alternative plant-based protein source for dog and cat dry diets. *Journal of Animal Science*, 102, skae244. <https://doi.org/10.1093/jas/skae244>
- Matias, D., & Martins, L. (2026). Food allergy in companion animals: Integrating traditional diagnostics with emerging approaches. *Applied Sciences*, 16(5), 2169. <https://doi.org/10.3390/app16052169>
- Paßlack, N., Thies, L. V., Vahjen, W., & Zentek, J. (2022). Effects of the protein concentration and quality in a canned diet on the fecal microbiota of healthy adult cats. *Metabolites*, 12(2), 105. <https://doi.org/10.3390/metabo12020105>
- Pinto, C. F. D., de Oliveira, B. B., Bortolo, M., Guldenpfennig, R., Marx, F. R., & Trevizan, L. (2022). Hydrolyzed chicken liver used as single source of animal protein in diet and its effect on cytokines, immunoglobulins, and fecal microbiota profile of adult dogs. *PLoS ONE*, 17(7), e0271932. <https://doi.org/10.1371/journal.pone.0271932>
- Ramos, P. D., da Silva, A. S., Boff, V. G., Cécere, B. G. d. O., Bajay, M. M., Sales, R. D. O. J., Neves, F. d. F., & Baretta, D. (2026). Combination of microalgae *Phaeodactylum tricornutum* and *Nannochloropsis oculata* in the diet of dogs and its impact on animal health. *Applied Phycology*, 7(1), 2632648. <https://doi.org/10.1080/26388081.2026.2632648>
- Reilly, L. M., von Schaumburg, P. C., Hoke, J. M., Davenport, G. M., Utterback, P. L., Parsons, C. M., & de Godoy, M. R. C. (2020). Macronutrient composition, true metabolizable energy and amino acid digestibility, and indispensable amino acid scoring of pulse ingredients for use in canine and feline diets. *Journal of Animal Science*, 98(6), skaa149. <https://doi.org/10.1093/jas/skaa149>
- Ribeiro, T. B., Maia, M. R. G., Fonseca, A. J. M., Marques, B., Caleja, C., Rosa, A., Martins, R., Almeida, A., Mota, M. J., Aires, T., Rocha, C. M. R., Teixeira, J. A., Cabrita, A. R. J., Barros, L., & Pintado, M. (2024). A comprehensive review of fish protein hydrolysates targeting pet food formulations. *Food Reviews International*, 40(8). <https://doi.org/10.1080/87559129.2024.2430660>
- Scarpim, L. B., & Pacheco, L. G. (2026). Challenges and methodologies to assess protein requirement and quality across different life stages in dogs: A review. *Animals*, 16(2), 228. <https://doi.org/10.3390/ani16020228>
- Stefanutti, D., Tonin, G., Morelli, G., Zampieri, R. M., La Rocca, N., & Ricci, R. (2023). Oral palatability and owners' perception of the effect of increasing amounts of spirulina (*Arthrospira platensis*) in the diet of a cohort of healthy dogs and cats. *Animals*, 13(8), 1275. <https://doi.org/10.3390/ani13081275>
- Summers, S., Quimby, J., Gagné, J., & Lappin, M. (2023). The effect of dietary protein concentration on the fecal microbiome and serum concentrations of gut-derived uremic toxins in healthy adult cats. *Veterinary Sciences*, 10(8), 497. <https://doi.org/10.3390/vetsci10080497>
- Vasconcellos, R. S., Volpato, J. A., & Silva, I. C. (2024). Bioactive peptides extracted from hydrolyzed animal byproducts for dogs and cats. *Animal Frontiers*, 14(3), 38–45. <https://doi.org/10.1093/af/vfae012>
- Vondis. (n.d.). Ostrich meat for dogs: A guide to novel proteins. Vondi's Holistic Pet Care.
- Vuthisophon, S., Kamonpatana, P., Promhuad, K., Srisa, A., Wongphan, P., Seubsai, A., Klinmalai, P., & Harnkarnsujarit, N. (2026). Advances in functional pet food research: Health-driven ingredients, nutritional targets and evidence-based claims. *Animals*, 16(8), 1222. <https://doi.org/10.3390/ani16081222>
- Wilson, S. (2025). Hydrolyzed protein and amino acid–based diets for management of adverse cutaneous or gastrointestinal food reactions. *Today's Veterinary Practice*, 12(5).
- Xian, Y., Yin, L., Wu, Z., Chen, D., Sun, Z., Jiang, X., & Tian, L. (2025). Characterization and preliminary safety evaluation of mycoprotein from *Fusarium compactum* MM-135. *Frontiers in Sustainable Food Systems*, 9, 1583642. <https://doi.org/10.3389/fsufs.2025.1583642>
- Yu, T., Humbert, F., Li, D., Savarin, A., Zhang, M., Cui, Y., Wang, H., Dong, T., & Wu, Y. (2025). Effects of chicken protein hydrolysate as a protein source to partially replace chicken meal on gut health, gut microbial structure, and metabolite composition in cats. *Veterinary Sciences*, 12(4), 388. <https://doi.org/10.3390/vetsci12040388>
- Zhang, M., Mo, R., Qu, Y., Li, M., Wang, H., Liu, P., Liu, T., & Wu, Y. (2025). Effects of supplemental seaweed extract on antioxidant properties, loose stools, gut microbiota, and its metabolite composition in adult dogs. *Journal of Animal Science*, 103, skaf149. <https://doi.org/10.1093/jas/skaf149>



PET FOOD
Edition

THANK YOU

Food Focus Thailand **2026**
ROADMAP
SPECIAL



Assoc. Prof. Dr. Attawit Kovitvadhi

CEO of ANLAR service Co., Ltd.



+66 89-2022-677



attawitthai@gmail.com