Common Dry Beans as a Novel Ingredient in Extruded Diets for Canine Weight Loss

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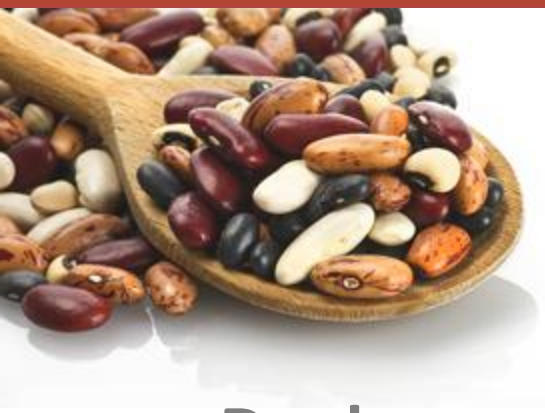

Overview

- Dry beans represent a novel ingredient in dog food and have the potential to modulate lipid and carbohydrate metabolism in dogs undergoing weight loss.
- Nutritional Metabolomics is a promising tool to assess the physiological changes in response to bean consumption.

Obesity Is the Most Common Nutritional Disorder in Dogs

- Over half the dogs in the U.S. are estimated to be obese or overweight.[1]

Obesity Is A Metabolic, Hormonal, and Inflammatory Disease

- Canine Obesity Leads to[2]:
  - Poor Quality & Quantity of Life
  - Musculoskeletal Disease
  - Cardiorespiratory Effects
  - Subclinical Conditions

[1]Ward. 2012 National Pet Obesity Survey Results

[2] Linder. Clinician's Brief. 2/25/2014

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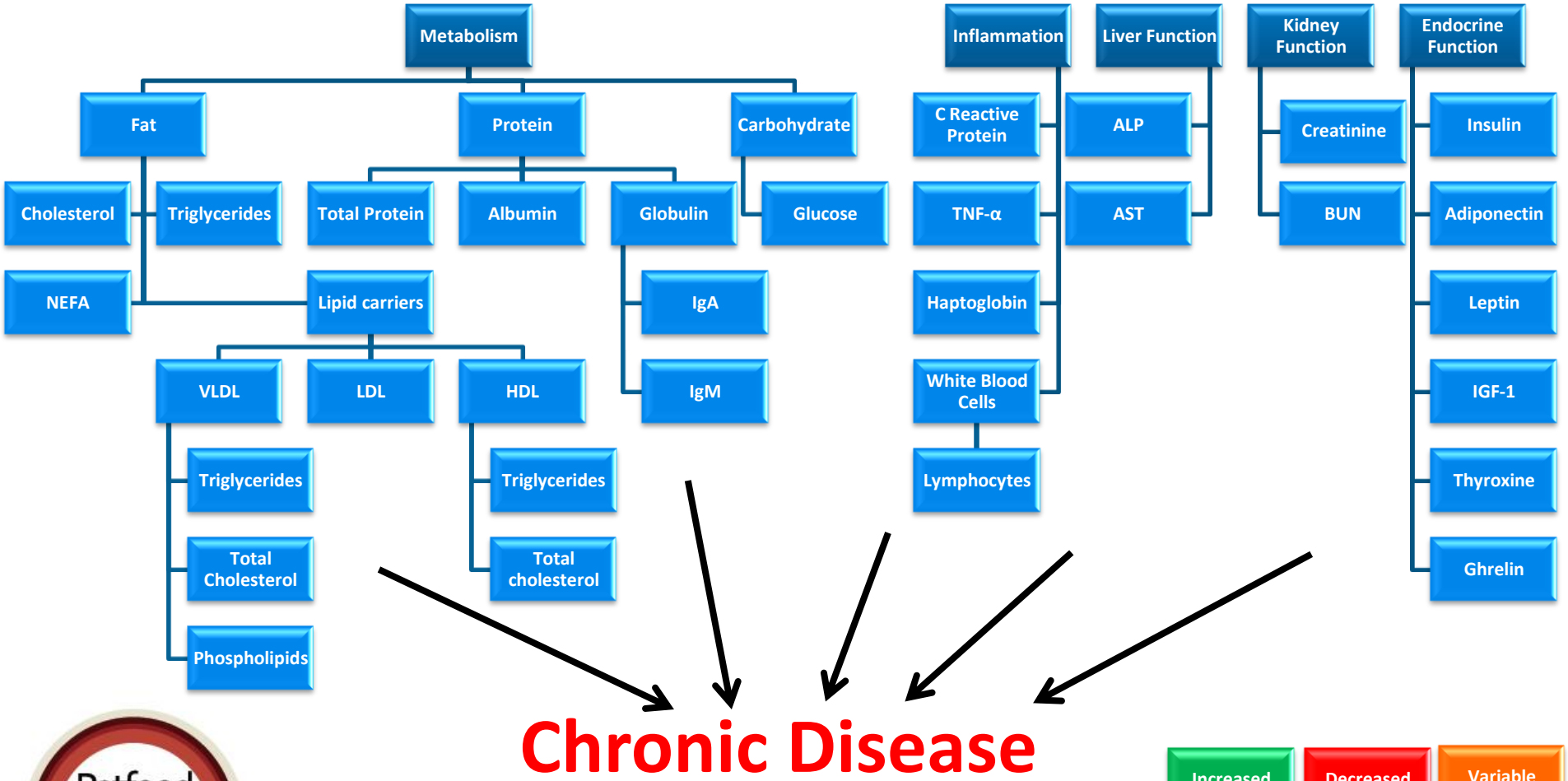
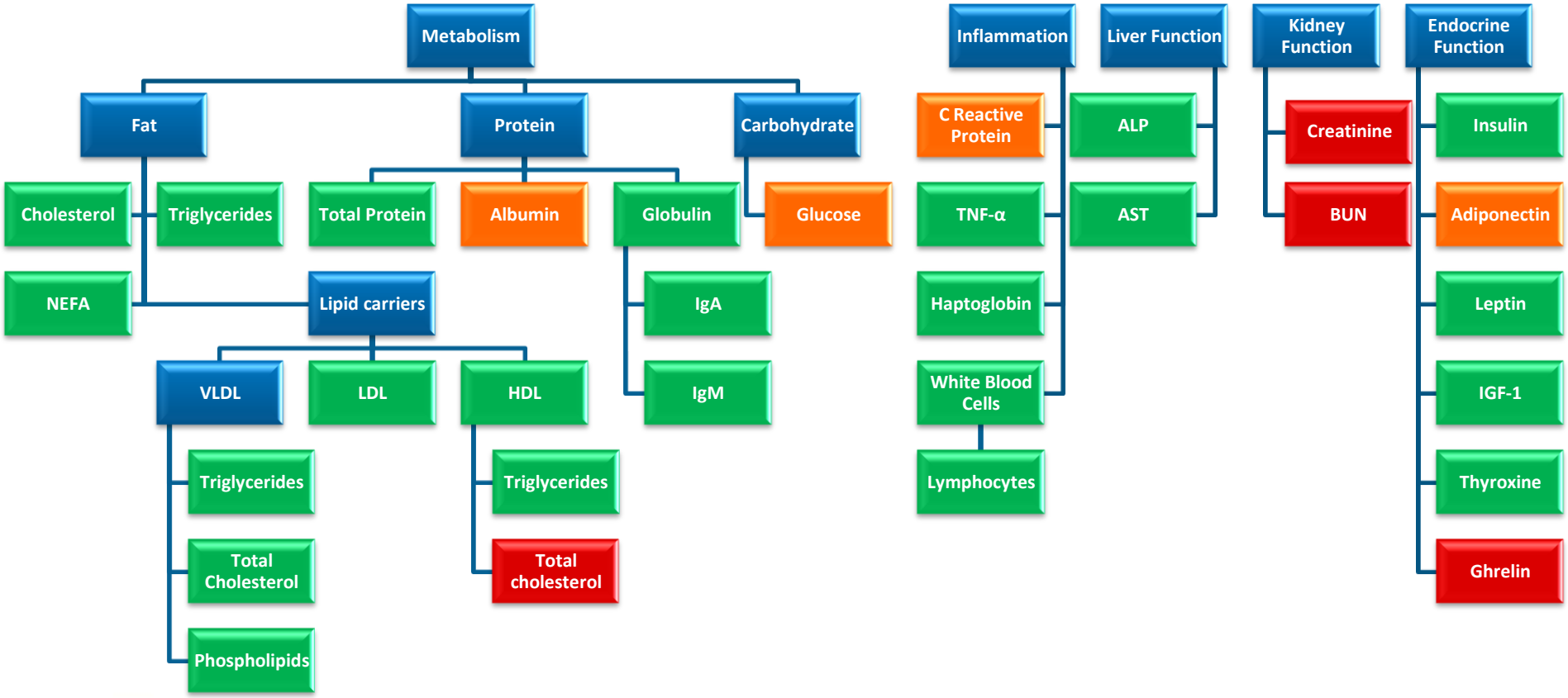
Metabolic Disturbances In Obese Dogs May Increase Risk for Chronic Disease



Weight Loss Reverses Metabolic Aberrancies



Dietary Components and Ingredients May Help Promote Weight Loss

- Protein
  - High protein diets may spare lean muscle mass.
- Fiber
  - Higher levels of insoluble fiber may promote satiety and have lower energy/kg.
  - Higher levels of insoluble fiber may promote cholesterol reduction.

Pulses are Dry Seeds Crops From the Legume Family

Legumes

Soybeans
Peanuts

Fresh Peas & Beans

Pulses
Peas, lentils, chickpeas, and dry beans.

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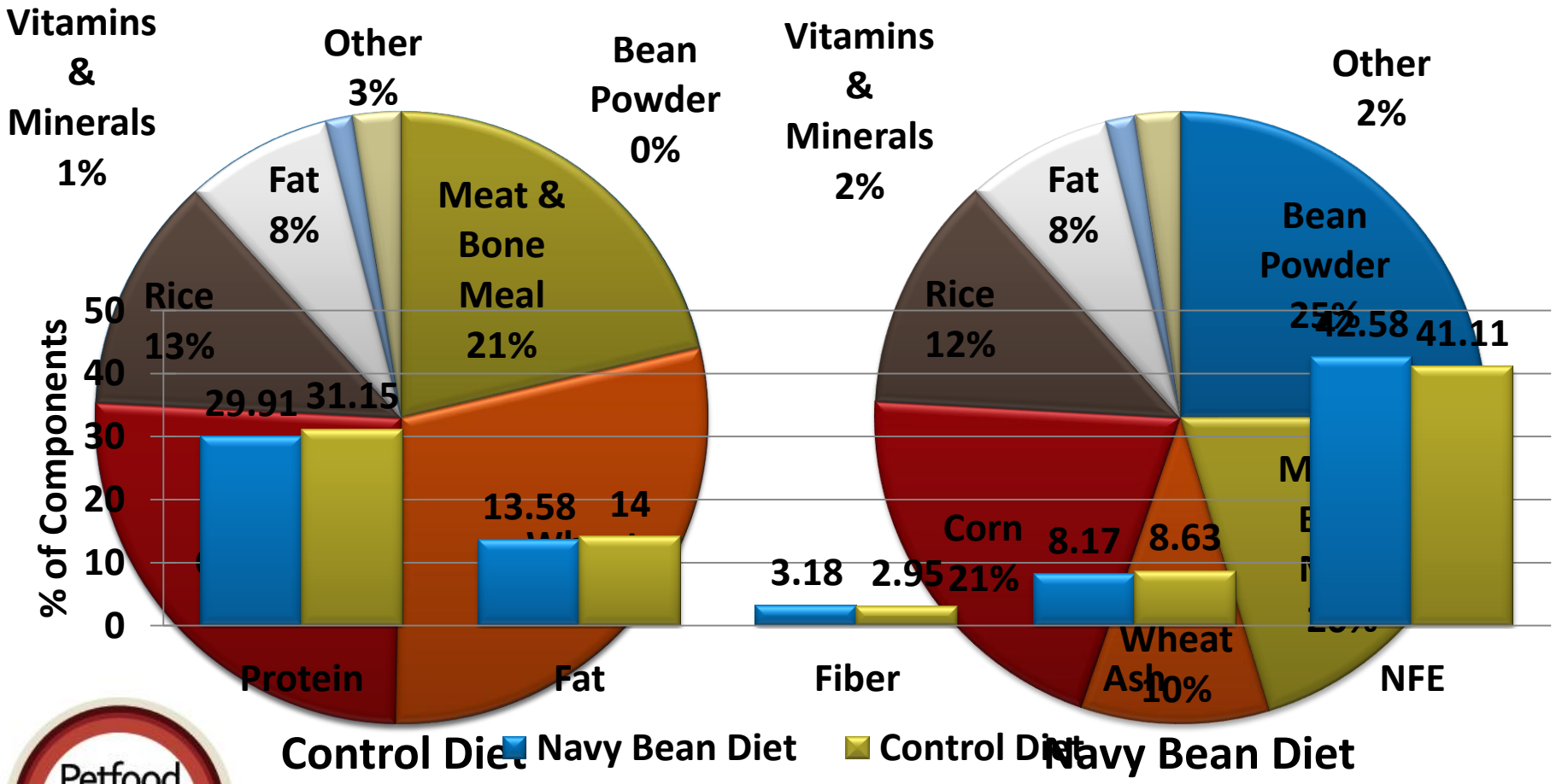
Health Promoting Properties of Dry Beans (*Phaseolus vulgaris* L.)

- Dry cooked beans have unique nutrient profiles compared to corn and cereal grains.
- Consumption of common beans has been shown to alter chronic disease processes and risk factors.
  - Reduce inflammation
  - Promote weight loss
  - Inhibit tumor growth
  - Alter tumor metabolism
  - Reduce serum cholesterol
- Common dry beans are a promising staple food for weight management and chronic disease prevention in dogs.

ARE BEANS SAFE AND DIGESTIBLE FOR DOGS?

Diet Formulations to Investigate the Safety and Digestibility of Navy Beans



Twenty-one clinically healthy adult dogs

Control Group N=11

Navy Bean Group N=10

Baseline

Blood, urine, and stool samples collected.

2 Weeks

Blood, urine, and stool samples collected.

96 hour fecal collection to determine digestibility.

4 weeks

Blood, urine, and stool samples collected.

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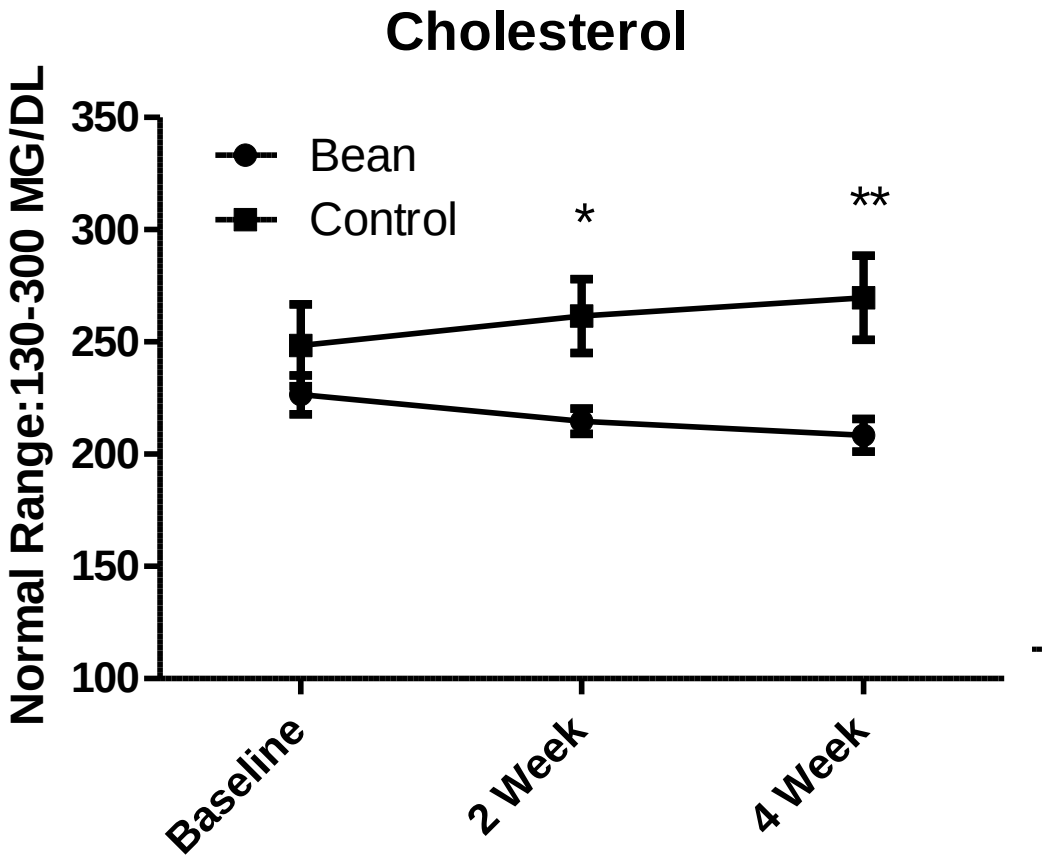
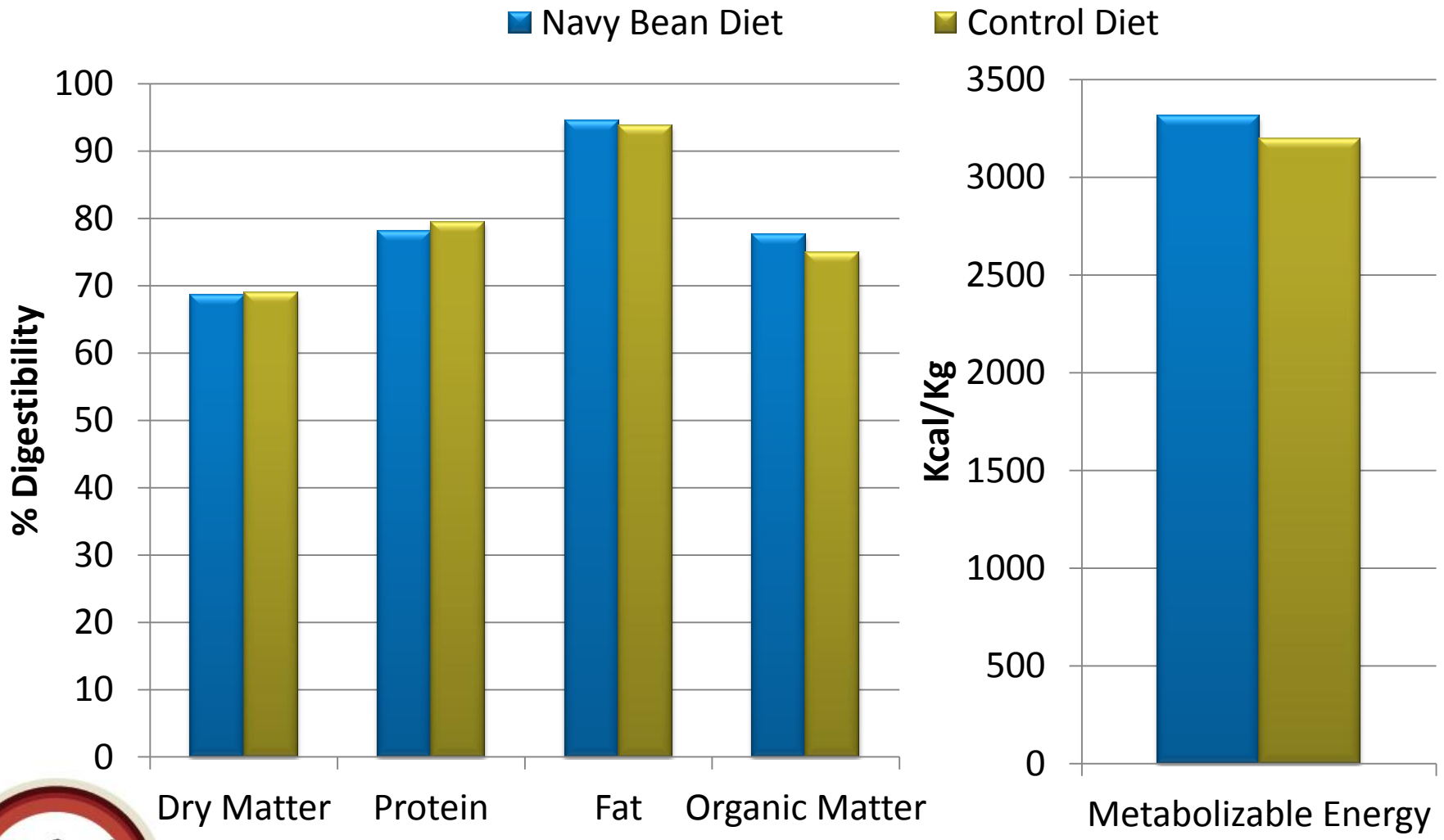
Biochemical Serum Analysis Demonstrates Safety of 25% Navy Bean Intake in Dogs



Proximate Analysis Demonstrates Digestibility of 25% Navy Bean Diets for Weight Maintenance



Forster et al. 2012. JAS

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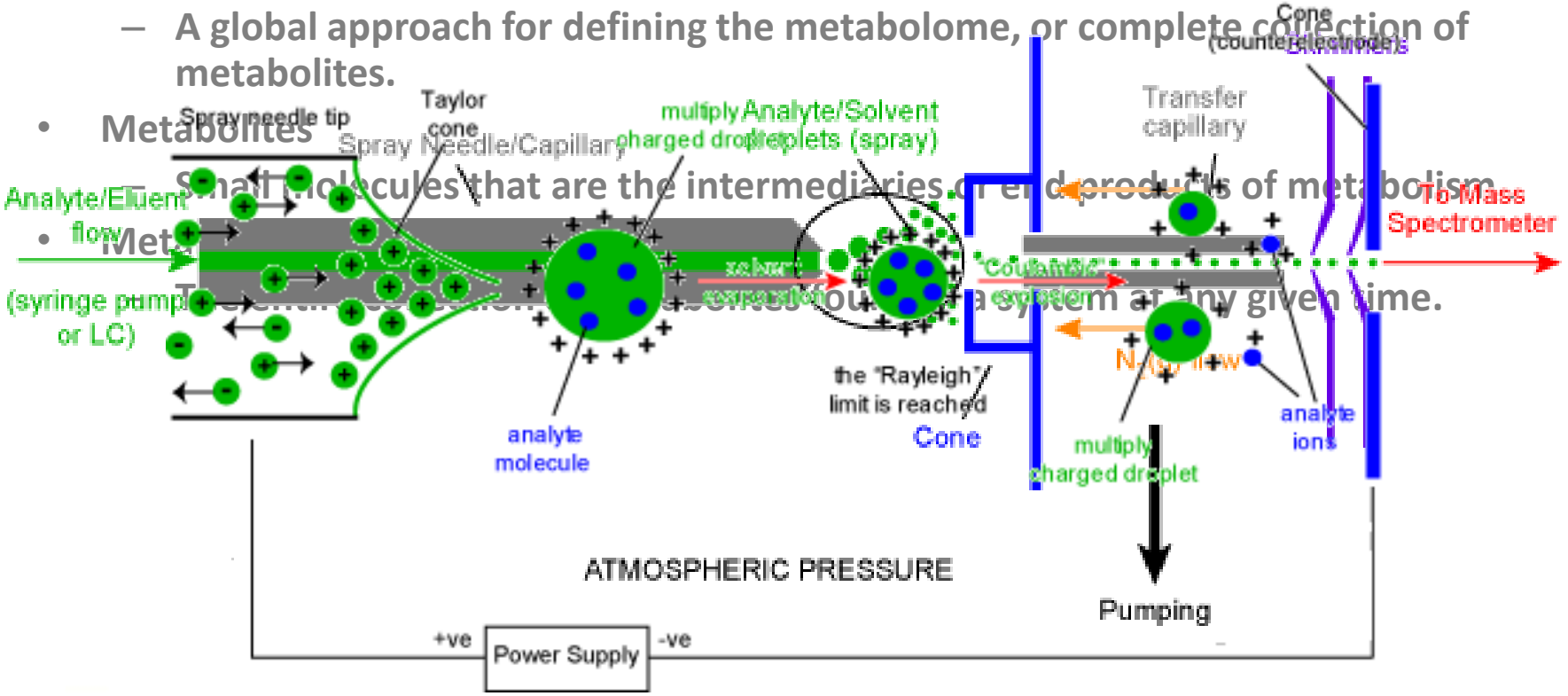
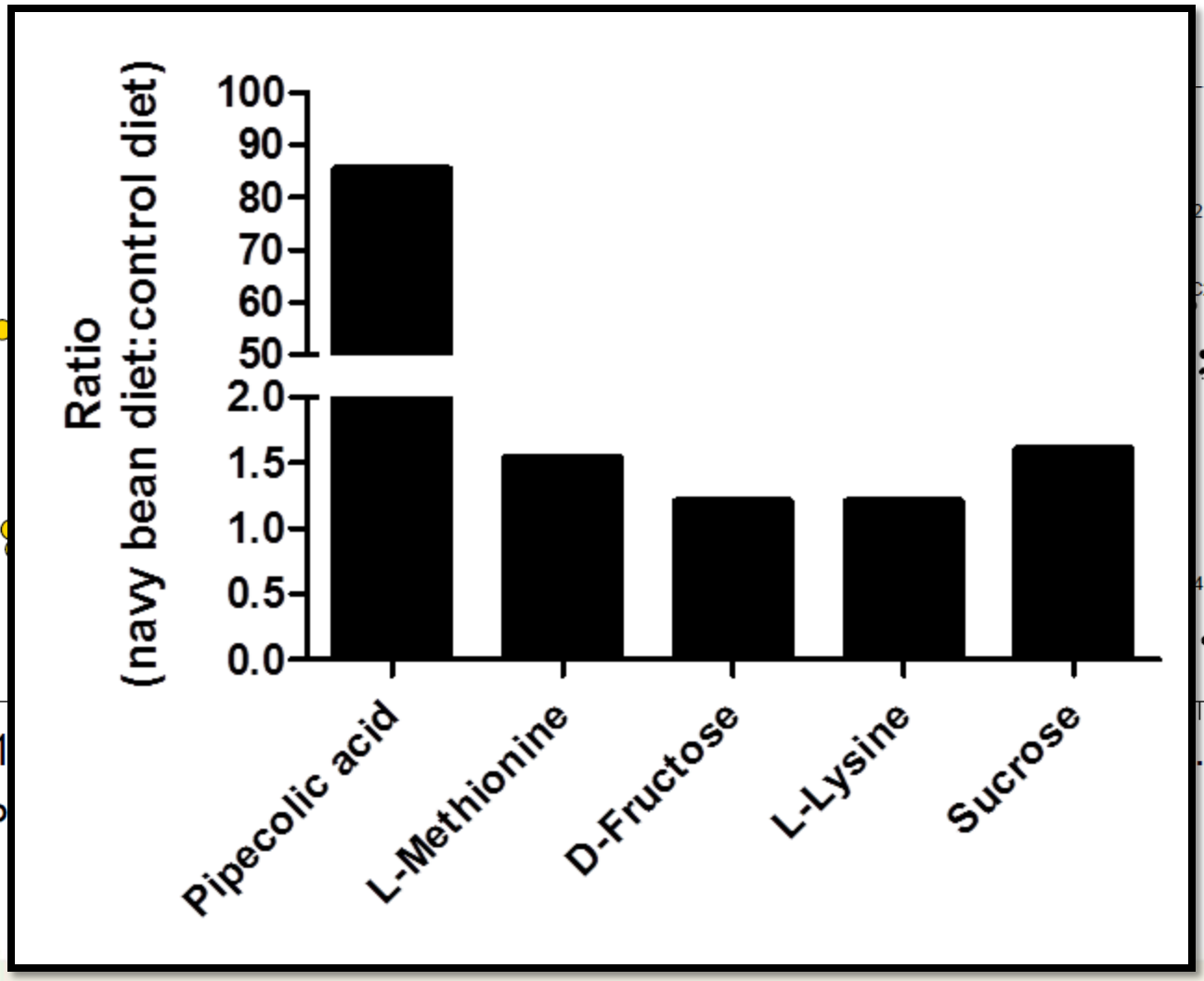
UTILITY OF METABOLOMICS TO ASSESS METABOLIC CHANGES IN RESPONSE TO DIET INTERVENTIONS

Metabolomics is a Novel Tool to Assess Functional Changes in Response to Diet

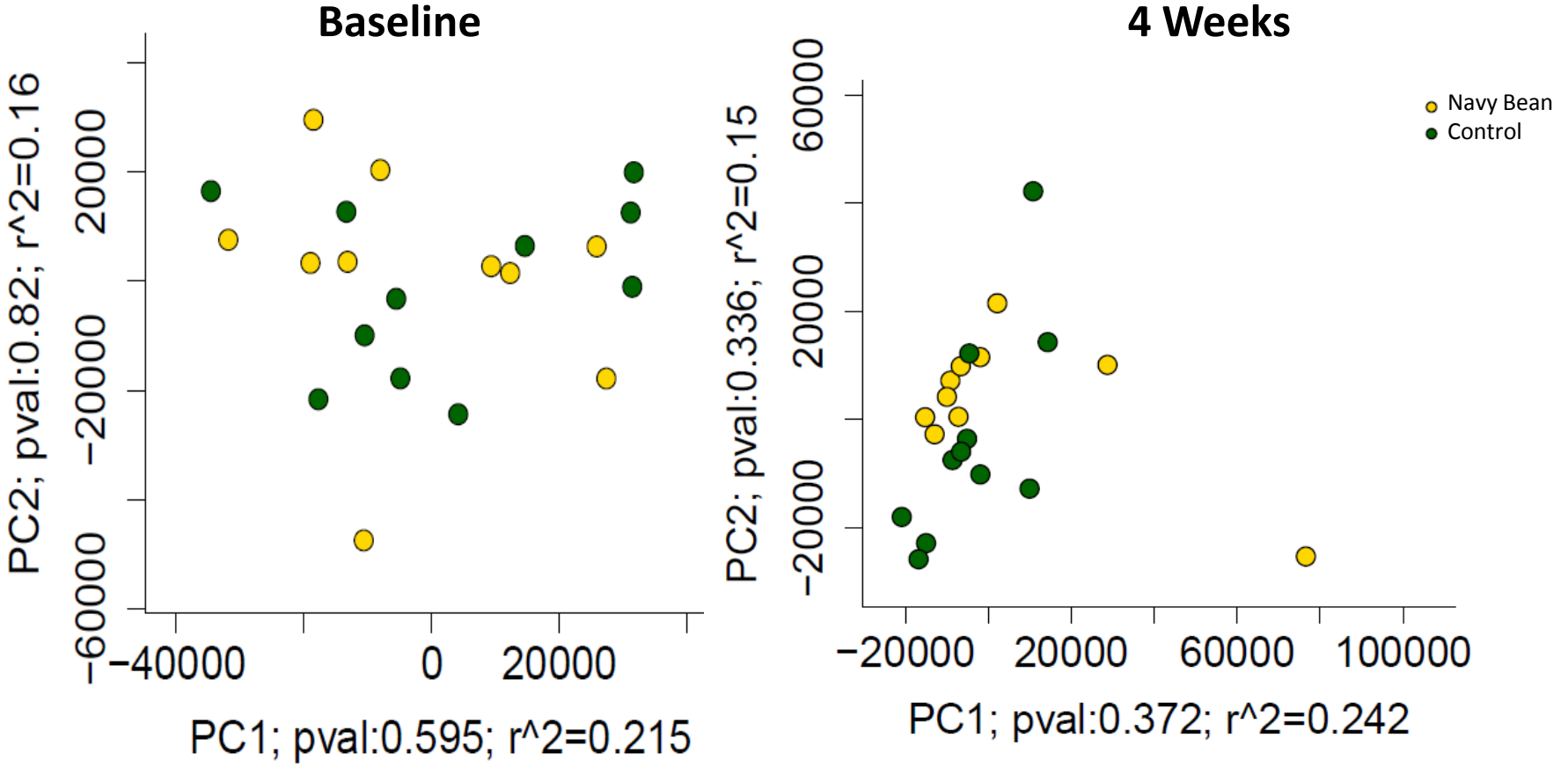
- Metabolomics
  - A global approach for defining the metabolome, or complete collection of metabolites.
- Metabolites
  - Small molecules that are the intermediaries or end products of metabolism.
  - Metabolome
  - The complete collection of metabolites found in a system at any given time.



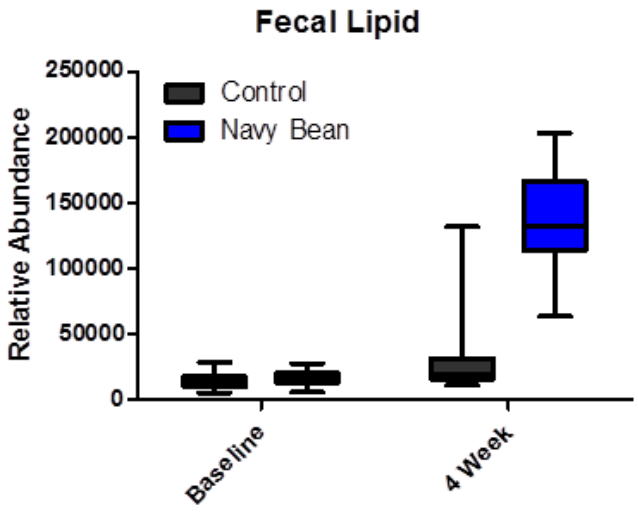
Metabolomic Analysis Reveals 41 Metabolite Differences Between the Navy Bean and Control Diet

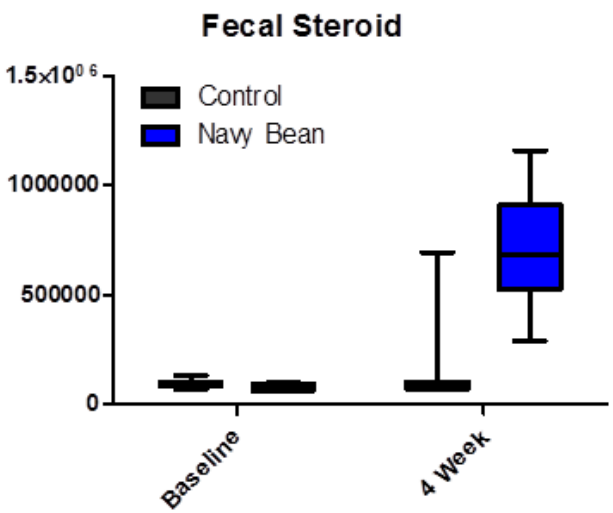


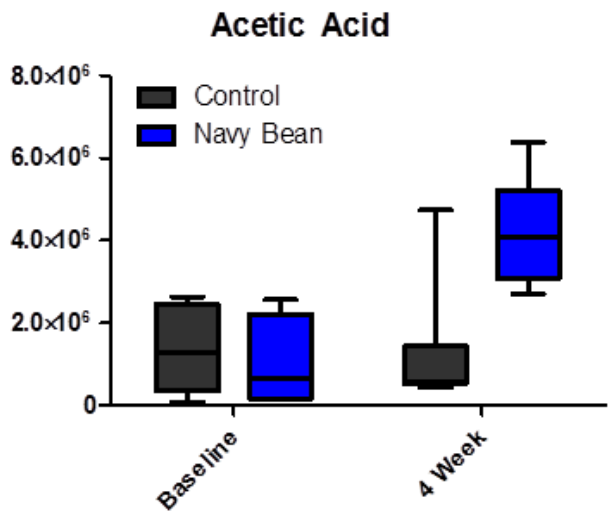
Bean Diets Induced Similar Changes in Canine Fecal Metabolome

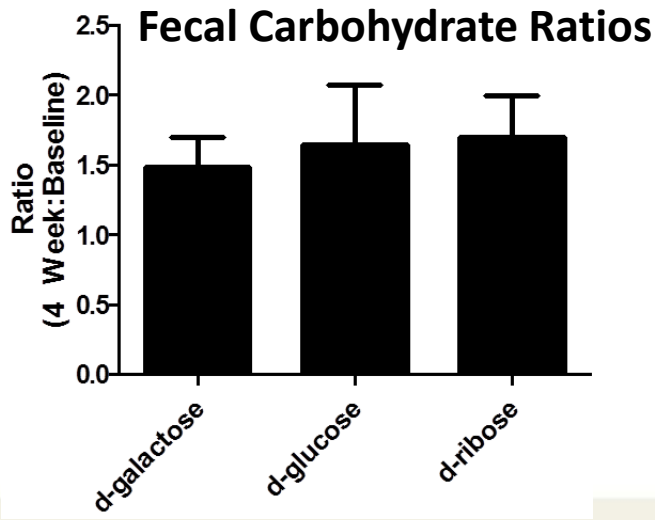


Nutrimetabolome Changes Detected in Fecal Samples





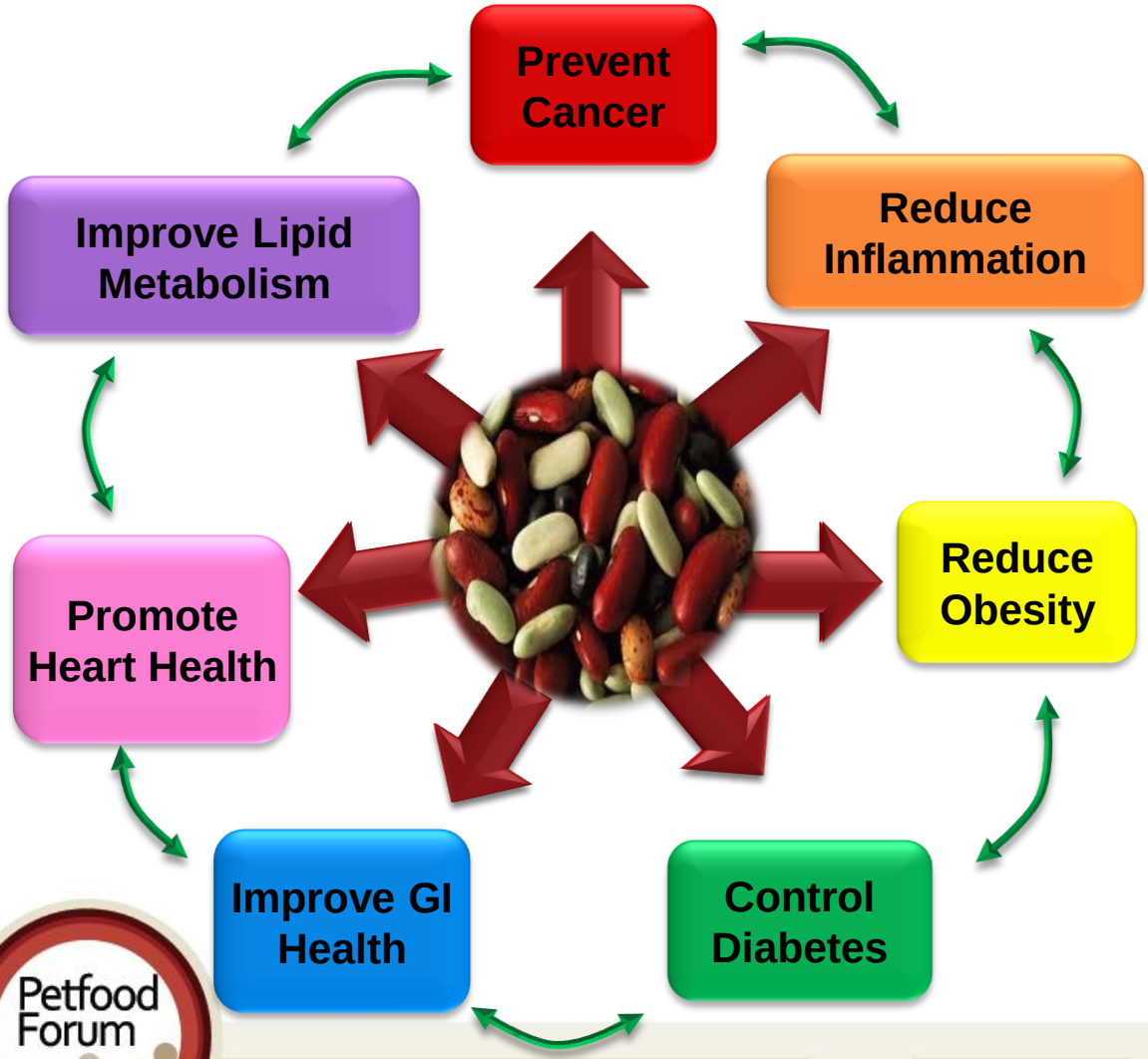




Conclusions from Healthy Weight Canine Study

- In clinically healthy, companion dogs, navy bean powder diets:
  - were well tolerated
  - digestible
  - have no adverse effects on canine blood analytes.
  - induce metabolic changes (lipids and carbohydrates).

Dry Beans Promote Weight Loss and Modulate Risk Factors for Chronic Disease



- Reduce Energy Intake
- Lower Blood Glucose Levels
- Decrease Waist Circumference
- Increase Insulin Sensitivity

Mollard, et. al. 2012.BJN

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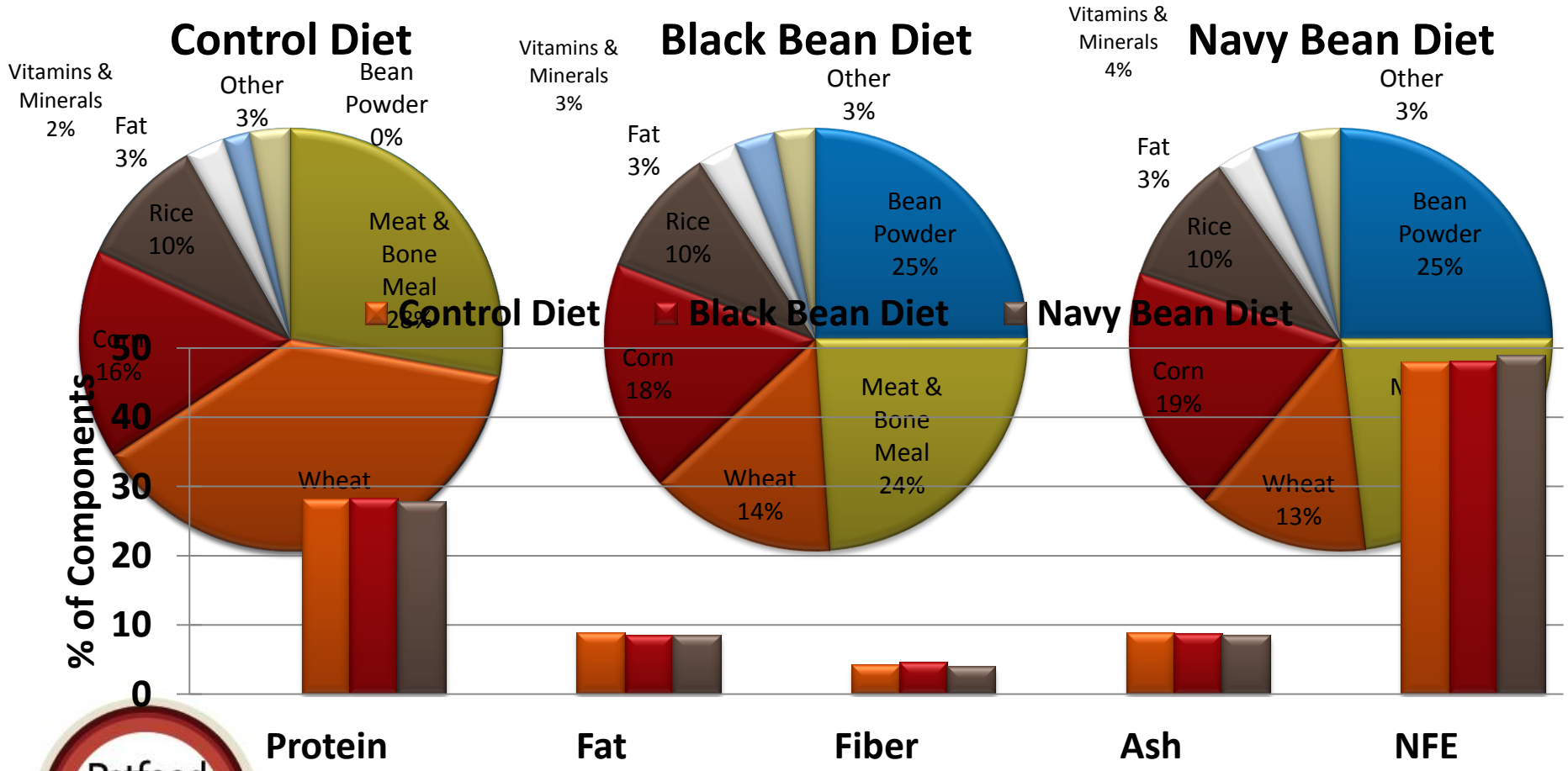
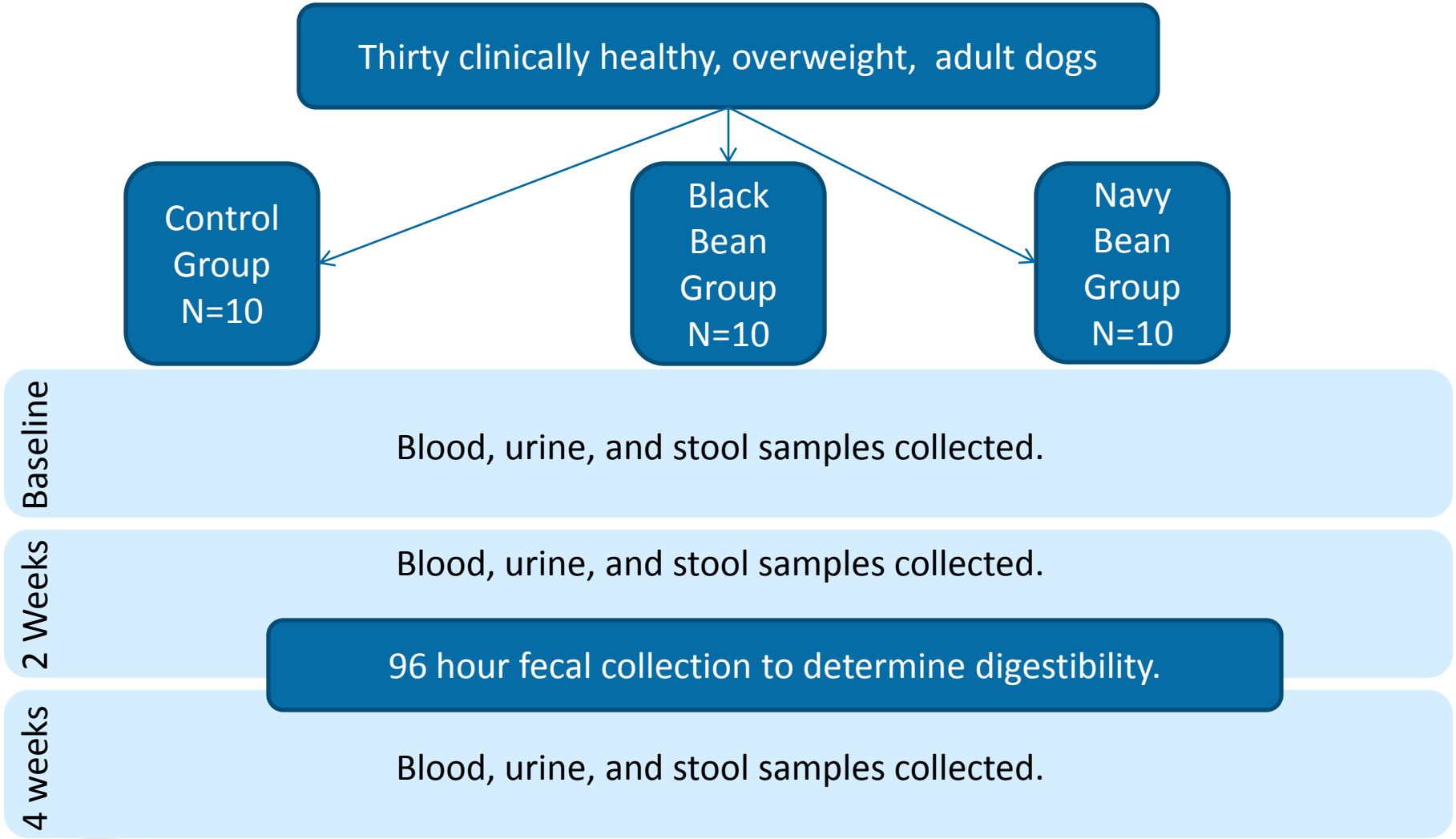
ARE BEANS SAFE AND DIGESTIBLE FOR DOGS UNDERGOING CALORICALLY RESTRICTED WEIGHT LOSS?

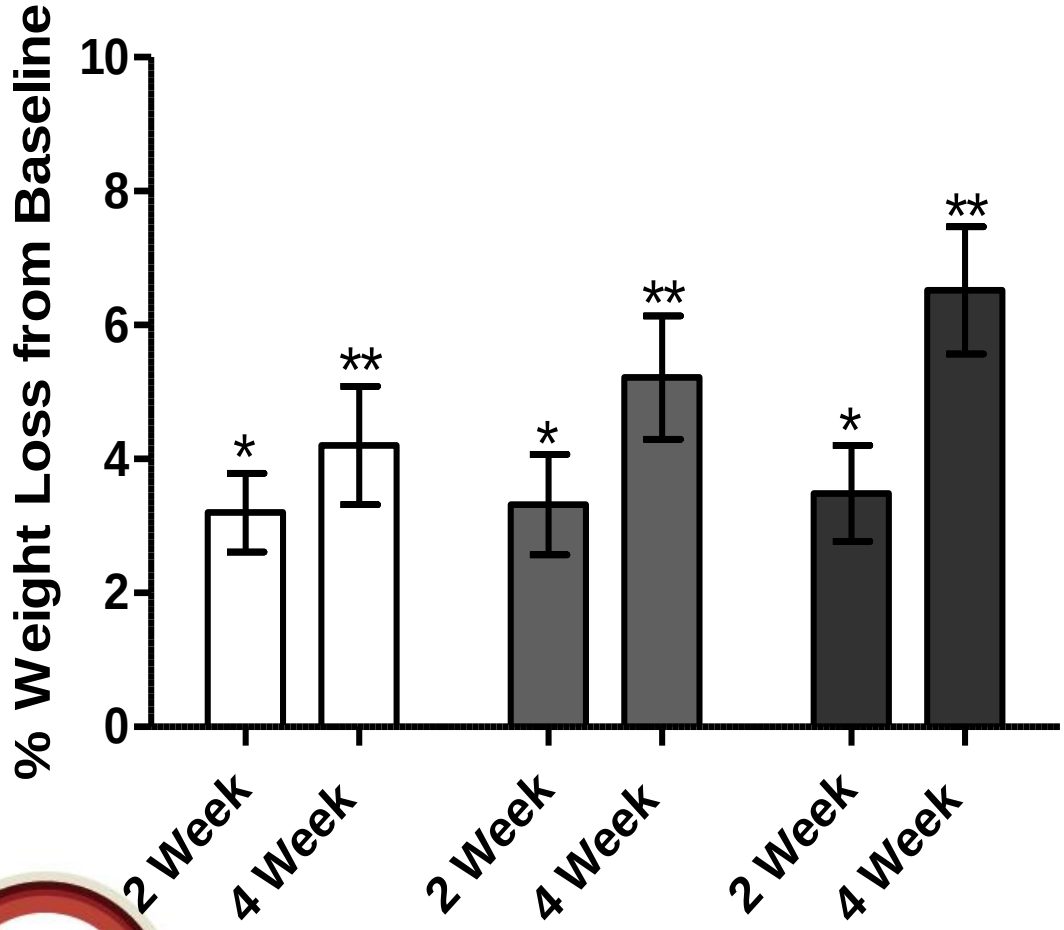
Canine Navy Bean, Black Bean & Control Diet Ingredient & Macronutrient Composition



Study Design to Evaluate Dry Beans for Canine Weight Loss



Overweight Dogs Underwent Significant Weight Reduction on Calorically Restricted Diets



Control Diet (N=10)
Black Bean Diet (N=10)
Navy Bean Diet (N=10)

*$P < 0.01$
**$P < 0.001$

Forster et al. (2012) J Obes Wt Loss Ther 2:149

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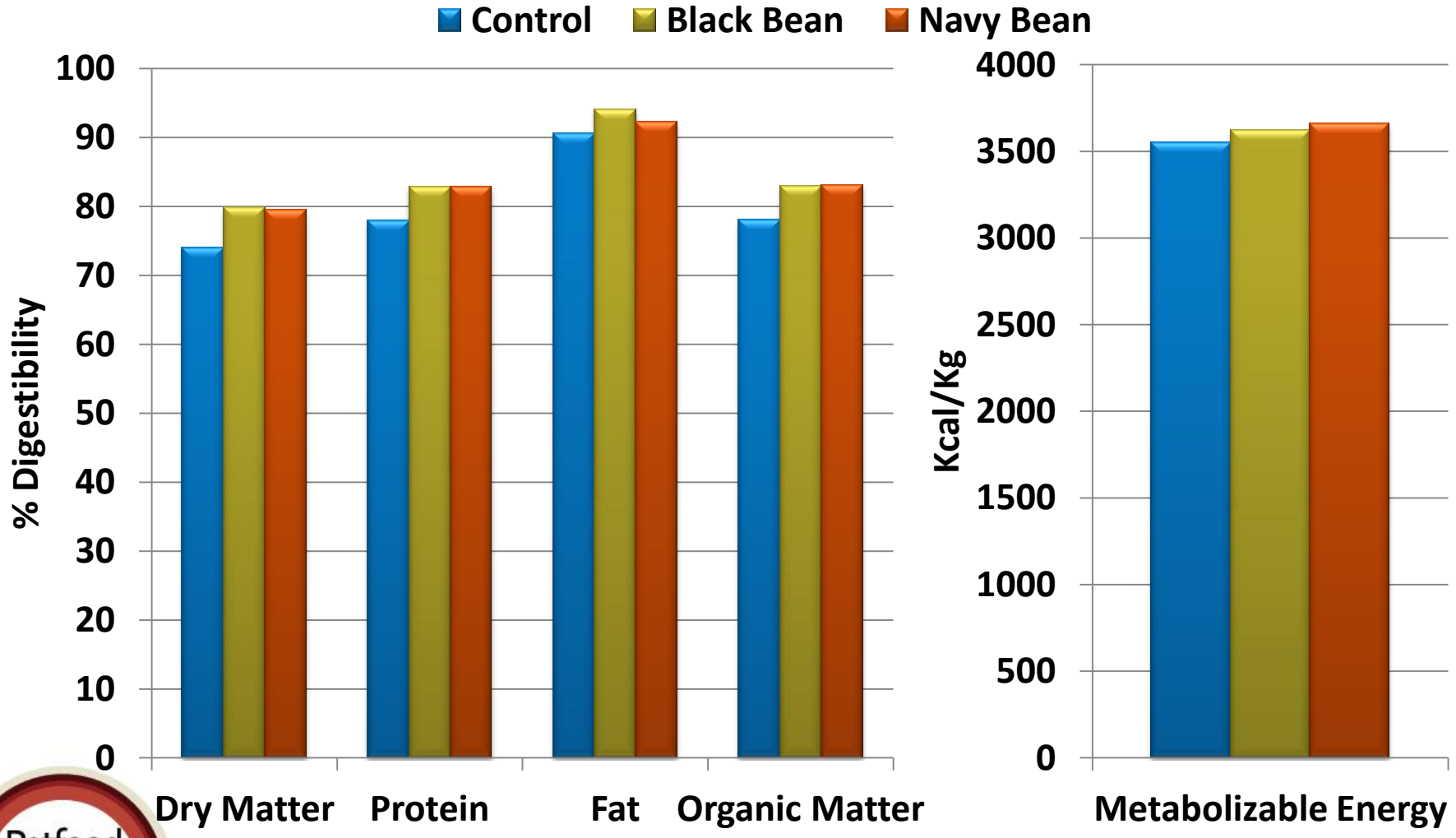
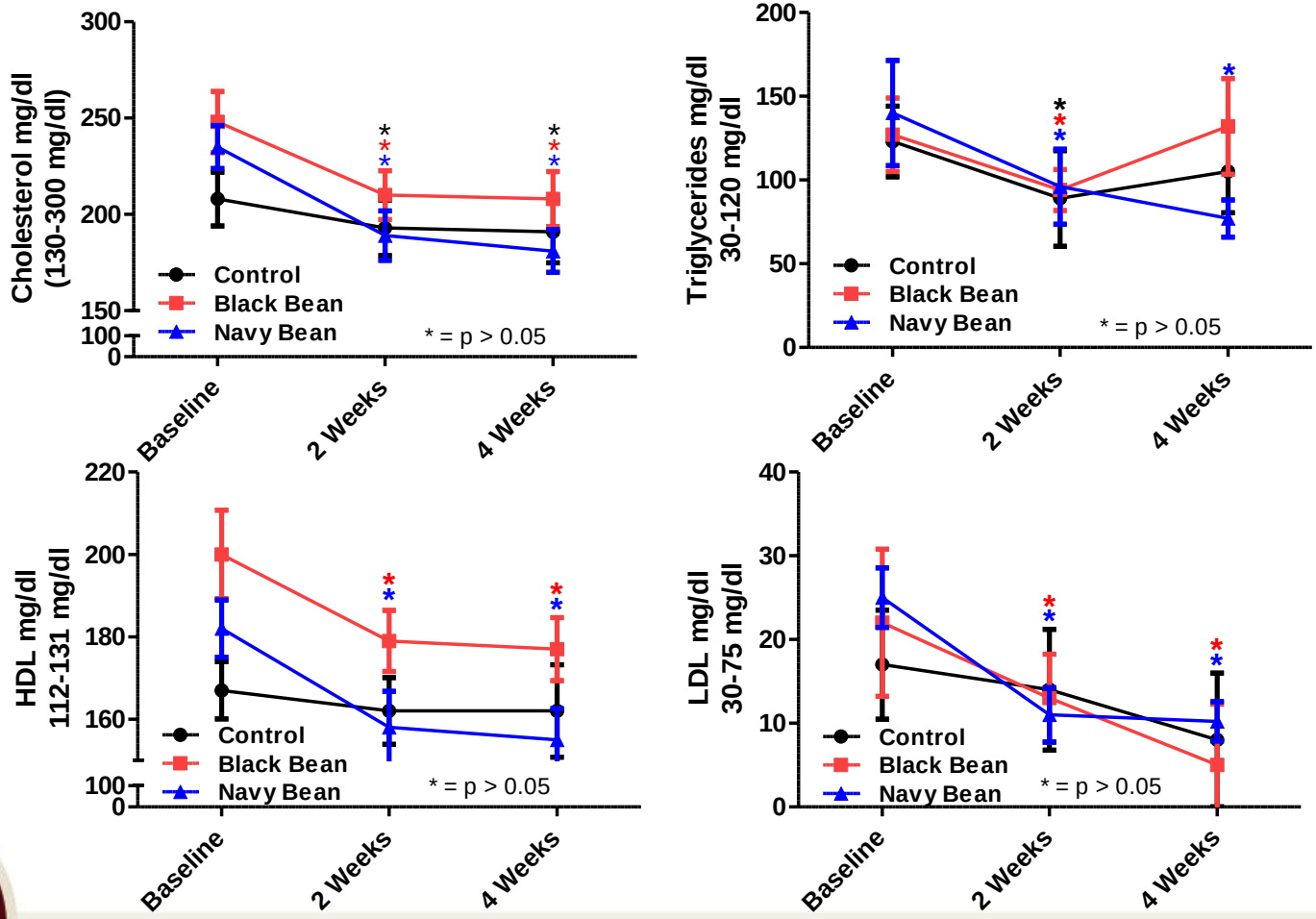
Navy and Black Bean Powders are Digestible by Dogs Undergoing Weight Loss



Bean Diets Induced Changes in Serum Lipids



Forster et al. (2012) J Obes Wt Loss Ther 2:149

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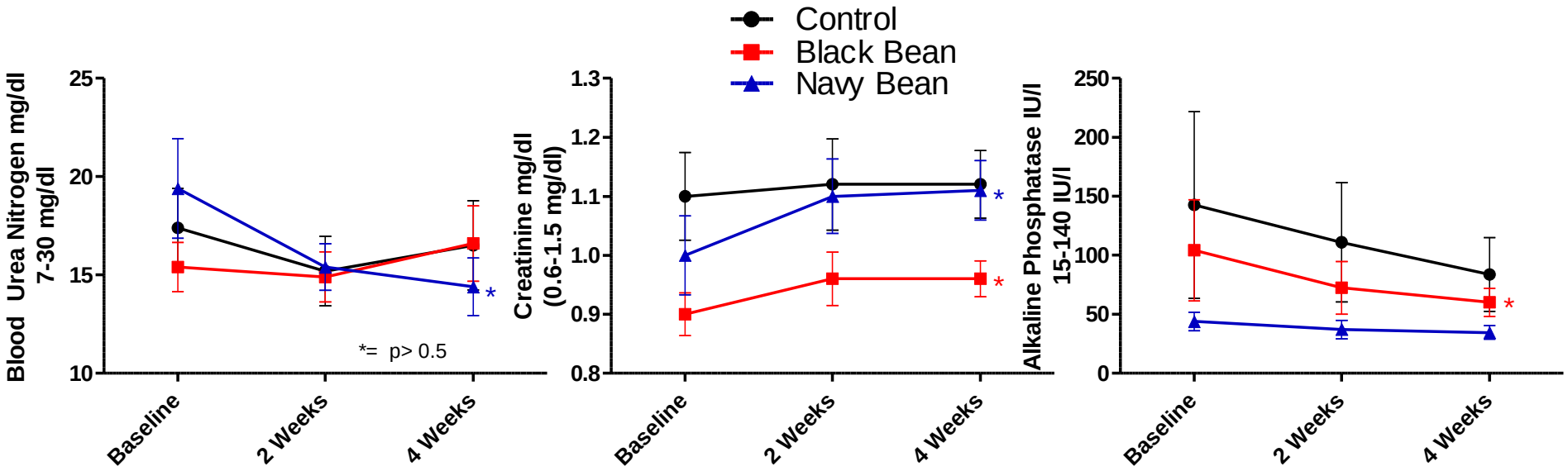
Bean Diets Induced Biochemical Metabolic Changes in Dogs Undergoing Weight Loss



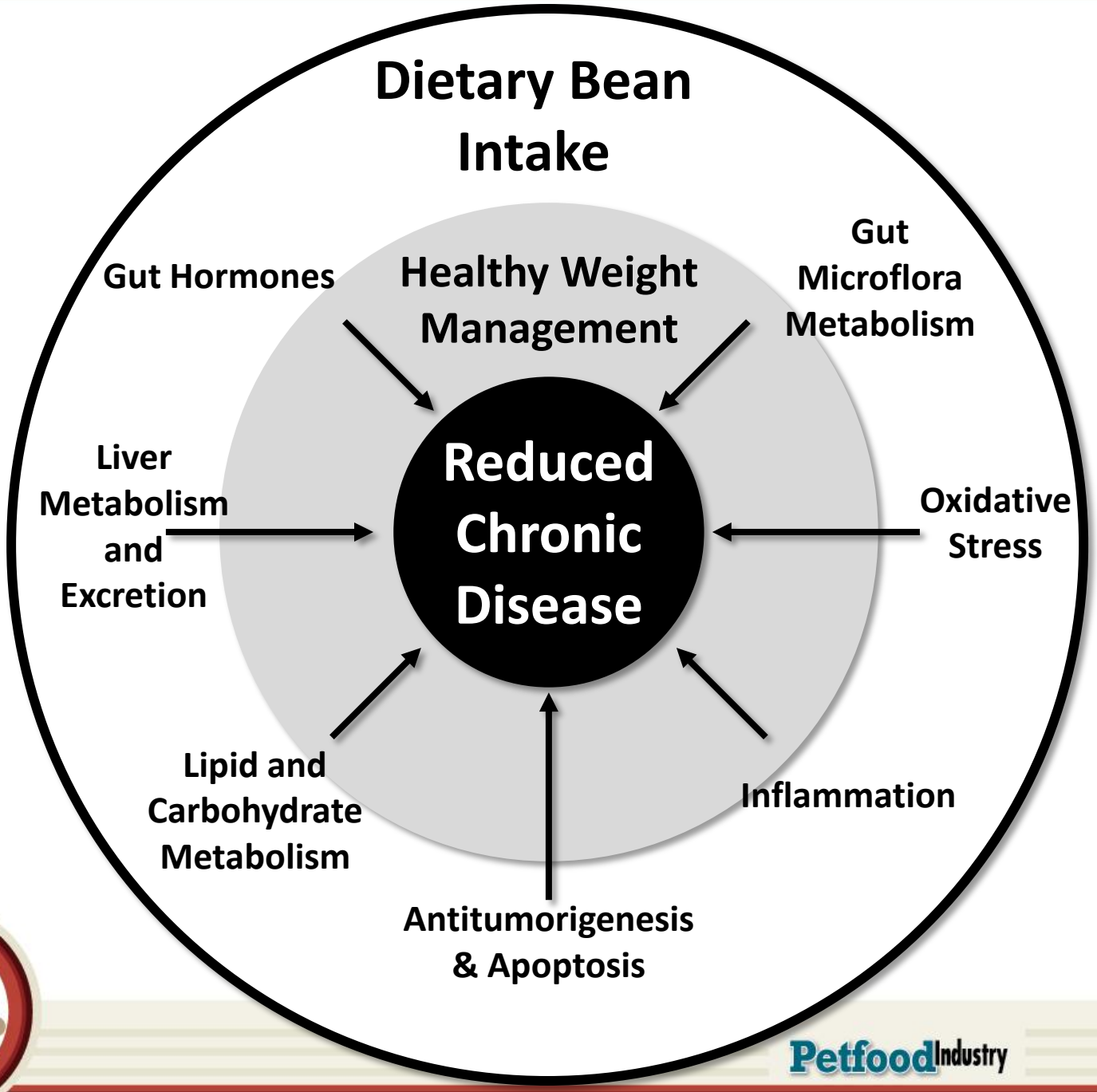
Forster et al. (2012) J Obes Wt Loss Ther 2:149

Conclusions from Dogs Undergoing Weight Loss with Cooked Bean Powder Diets

- 25% Navy and Black bean powder diets:
  - are well tolerated in overweight dogs
  - have no adverse effects on canine blood analytes.
  - are digestible compared to an isonutrient control diet.
  - induce lipid carrier changes in dogs undergoing weight loss.

Future Directions

- Metabolomic analysis of dogs undergoing weight loss.
  - Our goal is to determine the influence of bean consumption on lipid, carbohydrate and energy metabolism.
- Analysis of long term bean consumption in obese dogs to reach ideal weight.
  - 15 companion dogs have undergone a 6 month dietary intervention weight loss study with black and navy bean diets.
- Evaluate the effects of bean intake on cancer prevention in dogs.


Dietary Bean Intake
Healthy Weight Management
Gut Hormones
Gut Microflora Metabolism
Liver Metabolism and Excretion
Reduced Chronic Disease
Oxidative Stress
Lipid and Carbohydrate Metabolism
Inflammation
Antitumorigenesis & Apoptosis

Recommendations for Human Cancer Prevention

1. Be as lean as possible without becoming underweight.
2. Be physically active for at least 30 minutes every day.
3. Avoid sugary drinks. Limit consumption of energy-dense foods.
4. Eat more of a variety of vegetables, fruits, whole grains and legumes such as beans.
5. Limit consumption of red meats and avoid processed meats.
6. If consumed at all, limit alcoholic drinks to 2 for men and 1 for women per day.
7. Limit consumption of salty foods and foods processed with salt (sodium).
8. Don't use supplements to protect against cancer.
9. *It is best for mother breastfeed exclusively for up to 6 months and then add other liquids and foods.
10. *After treatment, cancer survivors should follow the recommendations for cancer prevention.

*Special population recommendations

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Dogs who consume vegetables at least 3 times/week had a 70% reduction in risk for transitional cell carcinoma

Model*	Type of vegetables consumed ≥ 3 times/wk† (yes vs no‡)	Odds ratio§	95% confidence interval	*P* value	Percentage reduction in risk
1	All types**	0.30	0.15, 0.62	0.001	70
2	Cruciferous	0.22	0.04, 1.11	0.07	78
3	Green leafy	0.12	0.01, 0.97	0.05	88
4	Yellow-orange	0.31	0.14, 0.70	0.005	69

*A separate model was built for each type of vegetable consumed. †The pattern of diet pertains to 1 year prior to diagnosis of TCC for cases and a comparable time period for controls. ‡No = Consumption of vegetable types < 3 times/wk. §The odds ratio associated with each vegetable type was adjusted for the same host factors, including age, weight, neuter status, and color of coat, but was not adjusted for the other vegetable groups, because of collinearity. **Includes cruciferous, green leafy, yellow-orange, and other vegetables (eg, tomatoes, green beans, green peppers, celery, and peas).

Raghaven M et al. JAVMA 2005;227(1):94-100

Shifting Dietary Patterns

- ↑ Dietary Energy
- ↑ Fat Intake
- ↓ Unrefined carbohydrates

Global Chronic Disease Burden in Humans

Decreased Energy Expenditure

- ↑ Motorized transport
- ↓ Physical Activity

"The proportion of the burden of non-communicable diseases attributable to Obesity, diabetes, CVD, hypertension, stroke, and cancer is expected to increase to 57% (from 46% in 2001) in 2020."

WHO Report 916.2003

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