

# Nutrition and Exposures: Maybe a Two Health Perspective?

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# Issues at hand.....

- Differences in eating patterns in humans vs. Dogs
- Humans rarely meet daily nutrient requirements
  - Rotation is what it felt leads to nutrient sufficiency – can be debated.
  - For dogs every bite is complete and balanced.
- Do the paradigms stand true?
  - Western diet leads to increased cancer risk?
  - Does obesity lead to increased cancer risk?
  - Does increased fruit and vegetable consumption lead to decreased risk?



# Western Nutrition and Cancer Risk

- Very little out there in the canine world
- Sonnenschein et al, 1991
  - Obesity early in life conferred an increased risk
  - High fat diets were not associated with increased risk
  - Survey Based of only 150 mammary cancer dogs and 131 case control dogs

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## Body Conformation, Diet, and Risk of Breast Cancer in Pet Dogs: A Case-Control Study

Elizabeth G. Sonnenschein,<sup>1</sup> Lawrence T. Glickman,<sup>2</sup> Michael H. Goldschmidt,<sup>3</sup> and Linda J. McKee<sup>4</sup>

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Dietary intake data obtained during the interview were used to calculate a diet profile, consisting of total intake, in grams and calories, of the five food types and the three major nutrients. To calculate the total intake profiles, we obtained caloric and macronutrient data for dog foods from commercial dog food companies, and we obtained human food nutritional values from standard sources (42, 43).

# Western Nutrition and Cancer Risk

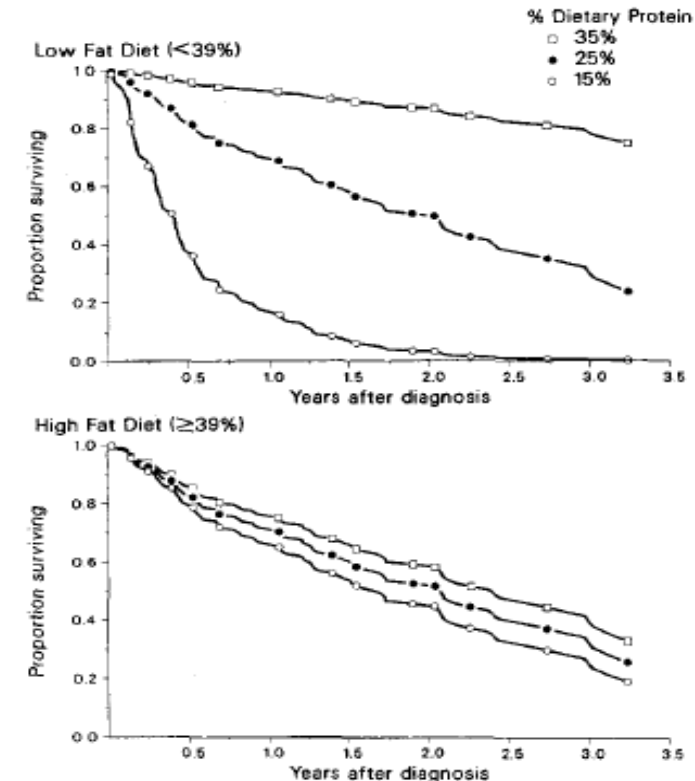
- 145 dogs followed after diagnosis of mammary carcinoma
- Higher fat diets may play a role in recurrence and survival
- Higher protein diets had an increased survival rate
  - Only when on low fat diets
- Are there differences in quality of low and higher protein diets??
  - Exposures??
  - Fat profiles? PUFA – omega three?

## *Report*

### **Histopathologic and dietary prognostic factors for canine mammary carcinoma**

Frances S. Shofer, Elizabeth G. Sonnenschein, Michael H. Goldschmidt, Larry L. Laster and Lawrence T. Glickman

*University of Pennsylvania School of Veterinary Medicine, Philadelphia, PA, USA*



# Does feeding Fresh Food alter risks?

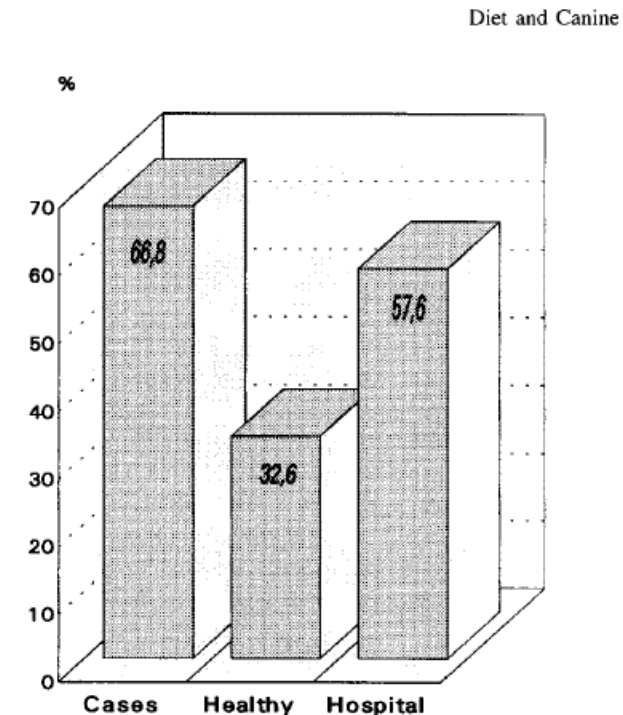
- Case-controlled Study
  - Survey of food intake and proportions
  - Must have been on the diet plan for over a year to be included
  - 102 cases – 88 controls
- Limited cases had serum Se and vitamin A assessed
  - Lower serum A in cases.
- Protein, fat, carbohydrate ME was similar across cohorts.

Cases and healthy controls (n = 129)					
Homemade food	0.018	0.005	1.02	1.01–1.03	.0004
Body condition at 1 year	1.458	0.604	4.30	1.30–14.2	.008
Age	0.268	0.097	1.31	1.08–1.59	.001

*J Vet Intern Med* 1998;12:132–139

## Relation between Habitual Diet and Canine Mammary Tumors in a Case-Control Study

Dolores Pérez Alenza, Gerard R. Rutteman, Laura Peña, Anton C. Beynen, and Pedro Cuesta



**Fig. 1.** The percentage of total caloric intake provided by home-prepared foods in cases and controls.

# What about Fruit and Vegetable and risk?

## Evaluation of the effect of dietary vegetable consumption on reducing risk of transitional cell carcinoma of the urinary bladder in Scottish Terriers

Malathi Raghavan, DVM, PhD; Deborah W. Knapp, DVM, MS, DACVIM; Patty L. Bonney; Marcia H. Dawson, DVM; Lawrence T. Glickman, VMD, DrPH

Vegetables consumed at least 3 times/wk and the risk of TCC of the urinary bladder in 87 case and 82 control Scottish Terriers.

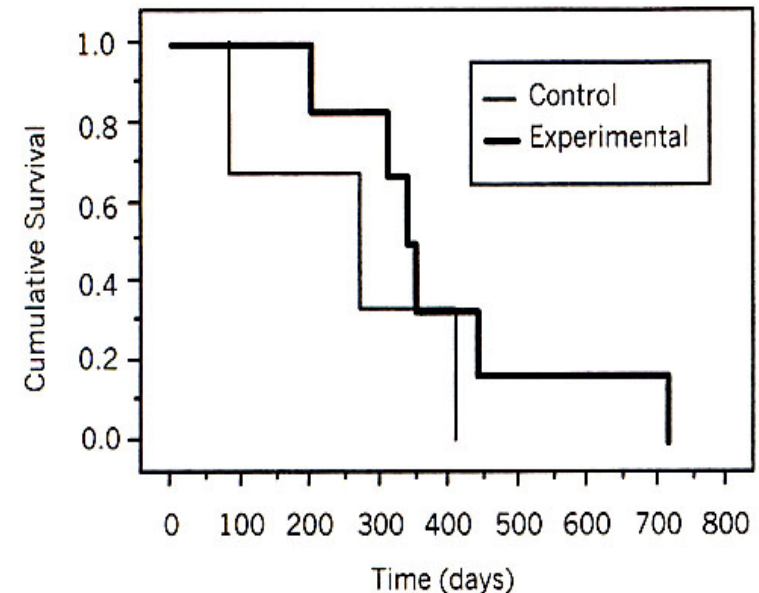
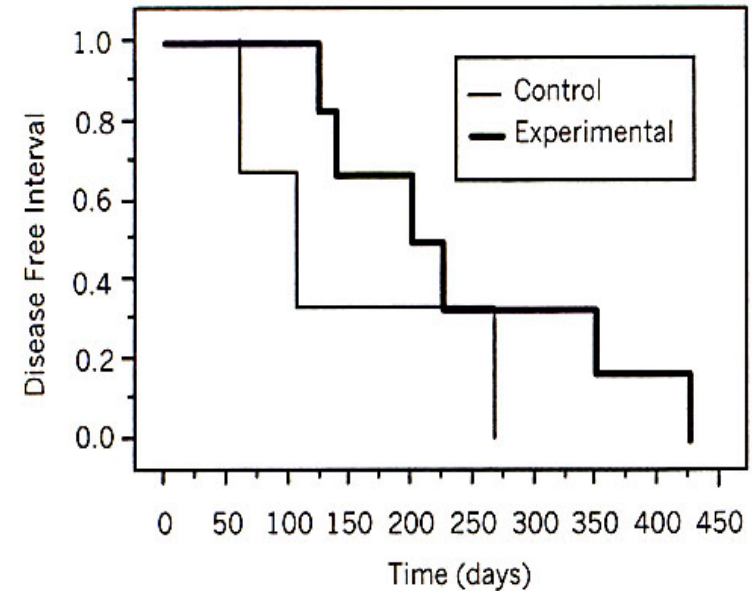
Model*	Type of vegetables consumed ≥ 3 times/wk† (yes vs no‡)	Odds ratio§	95% confidence interval	P value	Percentage reduction in risk
1	All types**	0.30	0.15, 0.62	0.001	70
2	Cruciferous	0.22	0.04, 1.11	0.07	78
3	Green leafy	0.12	0.01, 0.97	0.05	88
4	Yellow-orange	0.31	0.14, 0.70	0.005	69

\*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).

# Only clinical intervention study Lymphoma and Diet –Therapeutic Diets!

(Ogilvie et al 2000)

- Small Pilot study
- Higher fat diet fish oil enriched (Menhaden oil)
- Arginine added to diet.
- Diet correlated to DFI and survival.
- Considered a high protein and over 20% DM from fat (53% of energy).



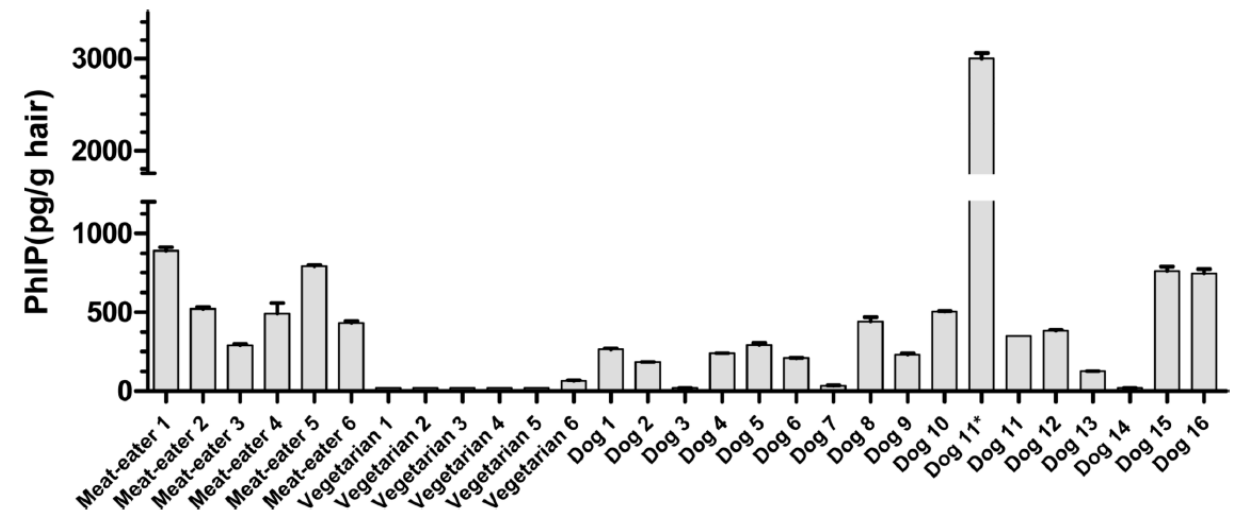


# Dog Food and Exposures?

- What is an unknown is exposure to mutagenic or hazardous chemicals?
- Dog food has been studied for heterocyclic amines and acrylamide.
- Heavy metal studies have been done on dog foods.
- The heating/retorting/extrusion process plays a role in formation of these hazardous chemicals.....
- Dog foods are double cooked
  - Production of meals initially
  - Extrusion process and drying

Gu et al.

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**Figure 4.** PhIP levels in hair of human omnivores and vegetarians, and fur of 16 canines. Dog 11 was assayed for PhIP at the age of 4 months\* and at the age of 4 years. The human data was adapted from reference 11.



# Heterocyclic amines (HCA)

- Nine Different HCA indentified as mutagens
- MeIQx, PhIP, DiMeIQx assessed in 14 dog and cat foods
- Salmonella mutagenicity assays done on 25 foods
  - Revertants ranged from 16-992 in dogs foods tested.
  - 3 fold differences when same food tested different lots.
  - Other mutagens expected.

Mutagenic activity and heterocyclic amine carcinogens in commercial pet foods

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For heterocyclic amines, total levels in restaurant-cooked meats ranged from 0.5 to 20.2 ng/g for a char-broiled steak [23]. Pet foods had a similar range of heterocyclic amines: five samples of the 14 tested had combined levels over 15 ng/g. We estimate that the dose of heterocyclic amines that pets receive to be 5-fold higher than the human dose, since the pet food is the exclusive diet of many pets, and we estimate cooked meat to be about 17% of the percentage by weight of the solid human diet based on USDA food surveys [24].

# Acrylamide

- Beagle studies suggest absorbed well in dogs.
- Dog studies suggest approximately 5.5 mg/kg has been associated with neurotoxicity.
- Much publicity around heated potato products due to soluble carbohydrate and asparagine creating acrylamide
- Typical 10 kg dog eats 200 grams of dry food
  - Range of consumption 0.02-0.08 mg total
  - 0.002 mg-0.008 mg/kg

*Analysed contents of acrylamide (µg/kg) in commercial dog and cat foods*

Ref	D/C	Dry/Wet	n	Mean	Range	Mean	Range
				µg/kg as is		µg/kg dry matter	
5	D	Dry	5	203	106 - 358	226	118 - 398
„	C	Dry	3	146	66 - 269	162	73 - 299
6	D	Dry	30	40	22 - 66	44	24 - 73
„	D	Wet 1	13	11	5 - 21	55	25 - 105
„	D	Wet 2	8	11	8 - 15	55	40 - 75

Beynen, 2021, Researchgate review  
Sugita et al, Fund Tox Sci, 2021  
Vesela & Sucman, Act Vet Brno, 2013

# CA prop 65

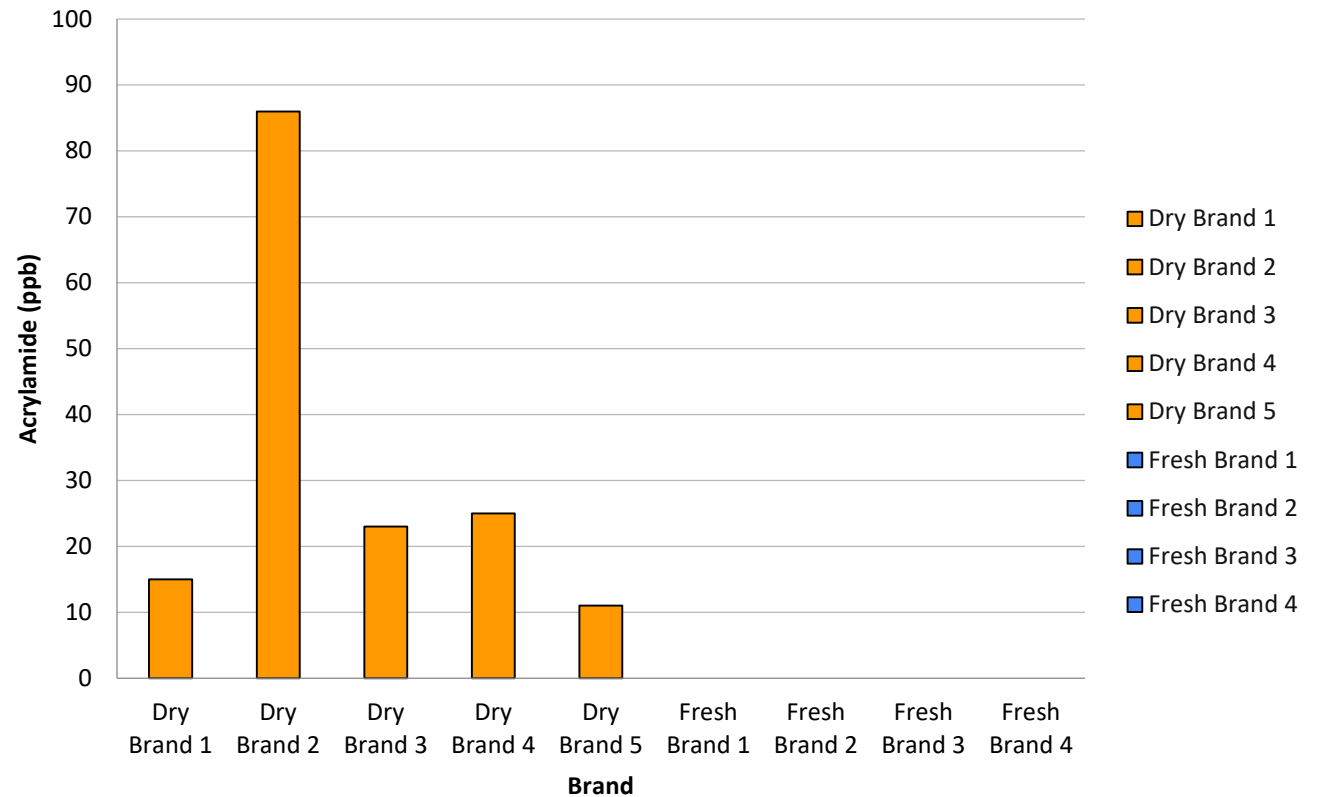
- Has been proposed that acrylamide metabolism to glycidamine which is a mutagen
- NSR limit is 0.2 ug/day max allow
- Maximal intake level 140 ug
- Average kid eating French fries every day
  - Mean 329 ug/kg (Mesias, Food Function, 2020)
  - 0.15 kg = 49 ug/day



# Acrylamide in dog food

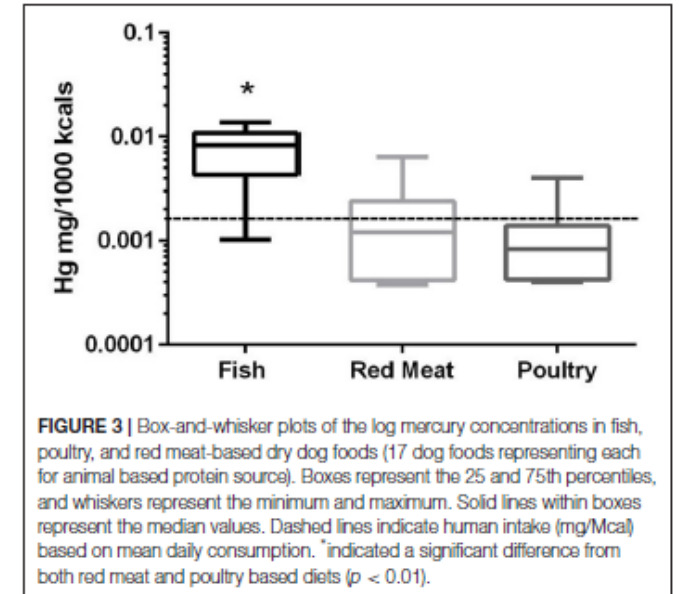
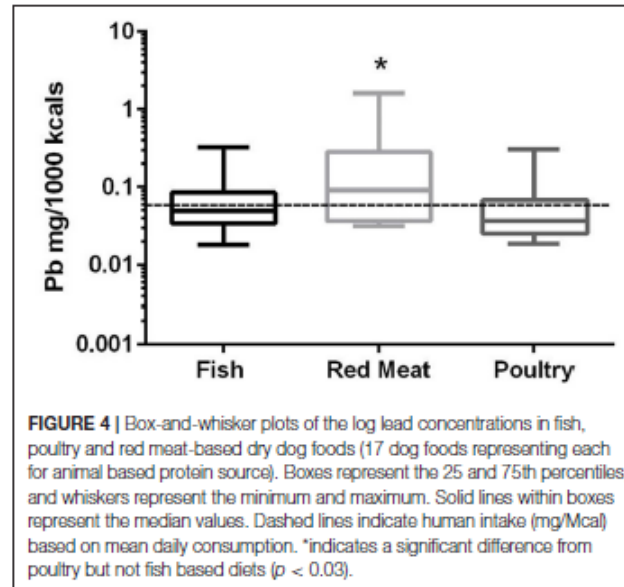
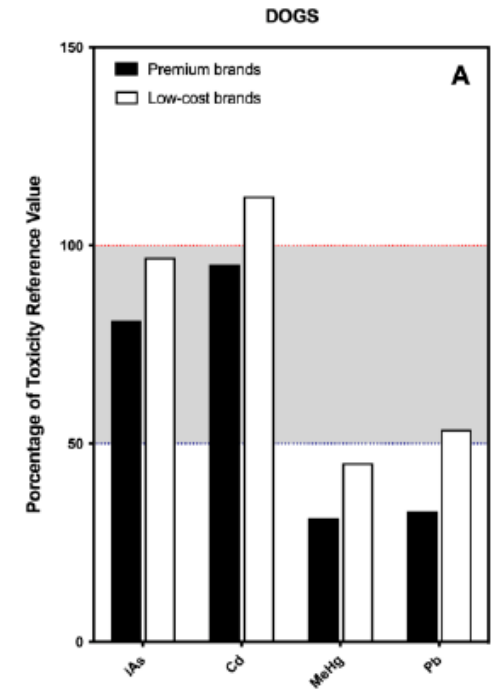
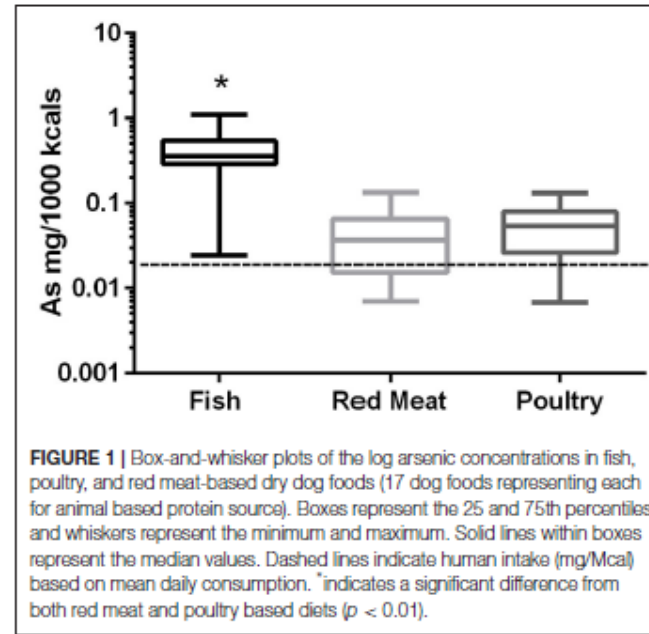
- Dog exposure likely similar to person eating French fries daily
- Example Dry brand 2
  - 85 ug/kg of food
  - 30 kg dog eating 400 grams a day
  - $0.4 \times 85 = 34$  ug/day
- Dog eats the same food every day!
- All dry foods would be above the 0.2 ug/day of prop 65 CA.
- Can we use dogs as the “canary in the cole mine” – now that dogs are being fed differently
- Approximately 5% of dogs fed a fresh food diet

Acrylamide Content of various pet foods (ppb)



# Heavy Metals and Dog Food

- Mercury, Lead, Arsenic and Cadmium
  - Conservative Toxicity Reference values suggest dog foods approach levels for cadmium and Arsenic (Macias-Montes et al, Toxics, 2021)
  - Consumption based on 2200 kcal suggests 3-7 fold higher consumption based on kcals consumed in dogs eating commercial kibble. (Kim et al, Front Vet Sci, 2018)
  - Very dependent on the protein base used.





# What is the utility of Diet in canine cancer research?



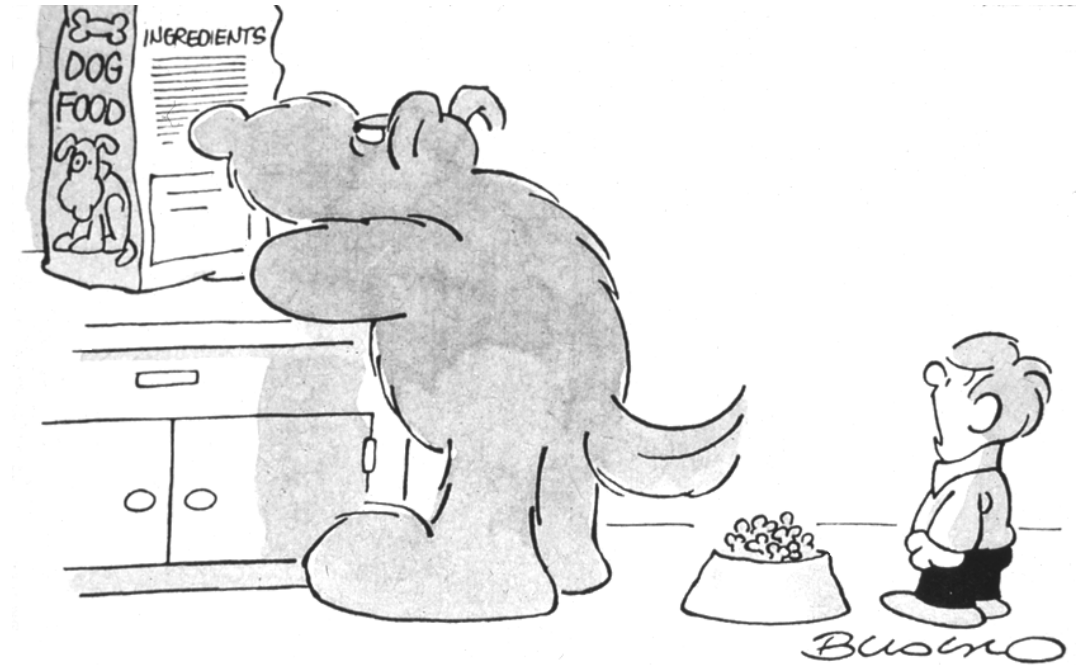
- Ability to control the intake of entire cohorts!
  - Nutrients over time will be consistent.
  - Aging and diet likely play a role
  - Vaika Aging project – chose a very typical diet (26% protein, 14% fat – complete and balanced).
    - Omnivorous style – minimal vegetables.
    - Poultry Based – minimize heavy metals
    - No potato base to minimize acrylamide issues
    - Not enriched with antioxidants (Sort of) or long chain omega three fatty acids.
- Dogs provide the perfect model for nutrition intervention studies!

<https://www.vaika.org/>



# What we need to know?

- Commercial Dog Foods
  - Currently no testing is required by companies regarding heavy metals, acrylamide or heterocyclic amine content of foods
  - Even detailed dietary studies such as GRL Study only asks what dog foods are being consumed and quantities.
    - Even consumers cannot tell you precise product
  - Do we need to start data bases?
    - How often should there be testing?
  - Can we learn something from dietary changes across the industry
    - Approximately 4-5% of dogs are being fed fresh, home prepared or freeze dried products.
    - Comparisons to traditional dry or wet dog food will provide some insights into how exposures differ.





Thanks !!

