The evaluation of protein and carbohydrate sources with an emphasis on their impact to taurine status in dogs

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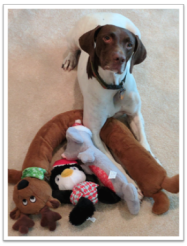
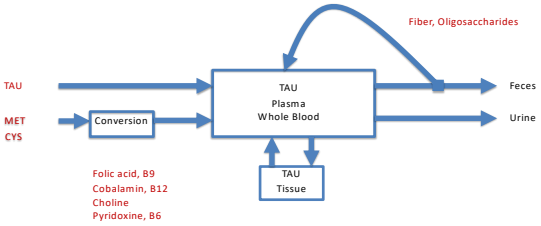
How do we unpack this topic?

- For a grain free diet to be a contributing factor to dilated cardiomyopathy in dogs several ingredient related factors must be demonstrated relative to lower circulating taurine.

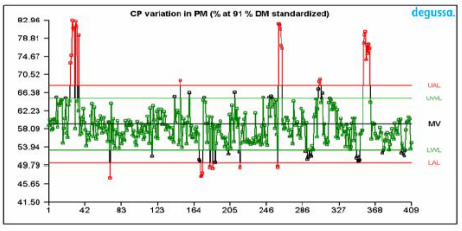
- OUTLINE
- Taurine in the balance
- Amino acid availability
- Polysaccharides and Bile Acids
- Pathway to formulation



Taurine Balance



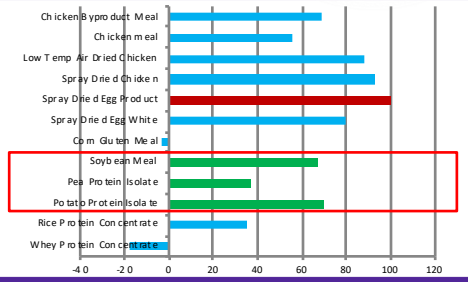
Variation in crude protein concentration in 409 samples of poultry by-product meal (1999-2002)



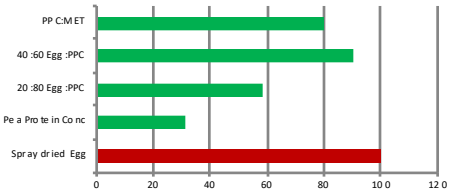
Amino acid (AA) concentration expressed as a % of total AA

Protein	CYS	MET	CYS+MET
Spray dried egg	2.1	3.3	5.4
Spray dried egg white	2.6	3.7	6.3
Chicken byproduct meal	1.4	2.1	3.5
Chicken meal	1.0	2.1	3.1
Low temp air dried chicken	1.1	2.8	3.9
Spray dried chicken	1.1	2.6	3.7
Whey protein concentrate	2.2	2.1	4.3
Corn gluten meal	1.6	2.4	4.0
Rice protein concentrate	2.0	2.7	4.7
Potato protein isolate	1.4	2.1	3.5
Pea protein isolate	1.0	1.1	2.1
Soybean meal	1.4	1.4	2.8

Protein Quality of Various Protein Concentrates using a Chick PER Assay



Protein Quality of Pea Protein Concentrate Supplemented with Egg or MET using a Chick PER assay



Canine ileal digestibility of diets containing rendered (PBPM) or fresh poultry (FP)

	PBPM	FP	P =
Organic Matter, %	78.9	85.4	.05
Crude Fat, %	88.3	92.7	.03
Protein, %	73.9	82.8	.03
TAA, %	77.3	86.4	.07
Lysine, %	80.1	89.5	.02
Methionine, %	84.7	93.4	.01
Cystine, %	60.8	73.4	NS

Soybean meal ileal digestibility in the dog

	Yamka '03	Clapper '01	Zou '96
Soy in diet, %	46.1	44.0	37.1
Ileal CP	51.1	85.3	77.4
TT CP	65.5	83.9	84.6
Ileal Lys	71.4	89.3	85.6
Ileal Met	63.5	85.7	72.6
Ileal Cys	30.0	70.8	29.7

Effects of extrusion cooking and soaking on nutritionally active factors[a] in faba and kidney beans[b]

Treatment	TI	CTI	α-AI	HgA	PA	CT	Pph
Vicia faba							
Raw seeds	4.47	3.56	18.9	49.3	21.7	1.95	3.92
Soaking	4.27	3.41	16.1	49.3	14.6	1.02	3.73
Extrusion	0.05	1.68	0.0	0.2	15.9	0.89	2.80
Phaseolus vulgaris							
Raw seeds	3.10	3.97	248	74.5	15.9	3.59	2.07
Soaking	2.93	3.37	220	74.5	15.0	2.72	1.64
Extrusion	0.43	0.00	0.0	0.2	12.6	0.58	1.12

[a] TI, trypsin inhibitors (IU mg^{-1} DM); CTI, chymotrypsin inhibitors (IU mg^{-1} DM); α-AI, α-amylase inhibitors (IU mg^{-1} DM); HgA, haemagglutinating activity (HU mg^{-1} DM); PA, phytic acid (g kg^{-1} DM); CT, condensed tannins (g equivalent catechin kg^{-1} DM); Pph, polyphenols (g kg^{-1} DM).

Alonso et al., 2000 except from Tran 2008

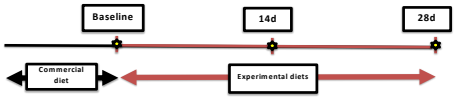
Short chain oligosaccharides measured in diets containing increasing levels of faba beans, and ingredients brewers rice

Item, ug/g	Brewers Rice	Dehulled Faba Beans	FB0	FB10	FB20	FB30
Sucrose	1,711	33,468	3,098	5,744	9,088	10,920
Raffinose	81.42	2,621	108	321.34	546.51	786.83
Stachyose	0.00	6,967	23.4	672.56	1423.21	2037.05
Verbascose	0.00	25,268	0.00	2,459.24	4968.29	7430.38

Ancient Grain vs Grain Free Evaluation in Dogs

- Animals
  - 12 Beagle dogs
  - Individually house
  - 6 dogs per treatment
- Diets
  - Adaptation period
  - Commercial diet
  - Experimental period

Grain-based (GB)
Grain-free (GF)



Pezzali et al 2020

MATERIAL AND METHODS

Ingredient composition of experimental diets

Item, %	Experimental treatment	
	Grain-based	Grain-free
Hydrolyzed pork protein	41.46	41.46
Spelt	16.57	-
Millet	16.57	-
Sorghum	16.58	-
Potato, white	-	16.57
Peas, green	-	25.91
Tapioca starch	-	7.23
Additives[1]	0.51	0.51
Chicken fat	4.00	4.00
Taurine	0.12	0.12
Titanium dioxide	0.40	0.40

50%

50%

[1]Additives = salt, potassium chloride, choline chorine (60% dry), vitamin premix, dicalcium phosphate, calcium carbonate, trace mineral premix, fish oil (menhaden), natural antioxidant, dry digest

MATERIAL AND METHODS

Chemical composition of commercial diet and experimental diets

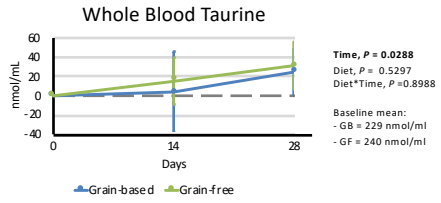
Item	Commercial Diet	Experimental diets	
		Grain-based	Grain-free
Moisture, % DM	7.4	6.51	7.43
Crude Protein, % DM	32.1	37.3	37.7
Crude Fat, % DM	18.5	12.1	10.4
Ash, % DM		4.24	4.33
Total dietary fiber, % DM	10.17	10.39	12.57
Insoluble fiber	8.47	8.30	8.65
Soluble fiber	1.70	2.09	3.92
Oligosaccharides, ug/g DM			
Raffinose	1,586	746	2,379
Stachyose	2,393	1,509	6,334
Verbascose	1,068	458	4,464
Total	5,047	2,713	13,178

MATERIAL AND METHODS

Essential amino acid composition of commercial diet and experimental diets

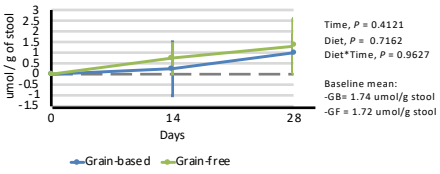
Item, % on as-DM basis	Commercial Diet	Experimental Diets	
		Grain-based	Grain-free
Arginine	1.55	2.17	2.4
Histidine	0.67	0.75	0.77
Isoleucine	1.14	1.54	1.59
Leucine	3.02	3.14	3.03
Lysine	2.21	1.99	2.31
Methionine	0.64	0.64	0.57
Methionine + Cysteine	1.04	1.28	1.18
Phenylalanine	1.43	1.79	1.80
Threonine	1.08	1.44	1.49
Tryptophan	0.20	0.35	0.36
Valine	1.36	2.03	2.10
Taurine	0.25	0.33	0.35

RESULTS AND DISCUSSION



RESULTS AND DISCUSSION

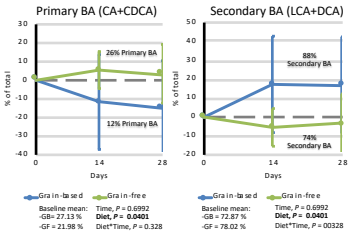
Total Fecal Bile Acids



Time, P = 0.4121
Diet, P = 0.7162
Diet*Time, P = 0.9627

Baseline mean:
-GB= 1.74 umol/g stool
-GF = 1.72 umol/g stool

Effects of different carbohydrate sources on taurine status in healthy Beagle dogs



- *Hypothesis:* Grain free pet foods will impact enterohepatic recirculation of taurine
- *Findings:* The grain-free diet (sufficient in sulfur-amino acids and taurine supplemented) did not impair taurine blood concentration and excretion of bile acids in healthy Beagle dogs.
- Dogs fed the grain-free diet exhibited higher excretion of primary bile acids as proportion of total compared to those fed a grain-based diet.
- *Impact:* Increased excretion of primary bile acid maybe due to a change in the microbiome which may impact taurine status.

RESULTS AND DISCUSSION

High proportion of primary BA

The primary BA are not efficiently being deconjugated by the gut microbiota

A reduction in the abundance or activity of bacteria capable of converting primary BA to secondary BA

What can we do about it?

- Eight factors to consider in formulation
  1. Assure high quality protein (bioavailable)
  2. Supportive levels of DL-Methionine (ratio of Met:Cys, 2:1)
  3. Supplement taurine?
  4. Assure adequate methyl donors: choline, betaine, Vitamin B6, Folic acid, Vitamin B12
  5. Judicious quantities of fermentable fibers and limit oligosaccharides
  6. Supplement L-carnitine (spare Met)
  7. Assure adequate omega 3 fatty acids (anti-inflammatory)
  8. Assure sufficient Selenium & Vitamin E (antioxidants)

Thank you