



Hydrosoluble vitamins for cats and dogs: current knowledge

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Hydrosoluble vitamins

B-vitamins

B1 (Thiamine)

B2 (Riboflavin)

B3 (Nicotinic acid)

B5 (Pantothenic acid)

B6 (Pyridoxine)

B7 (Biotin)

B9/B11 (Folate)

B12 (Cobalamin)

Vitamin C (ascorbic acid)

Vitamin	Sources
Thiamine (B ₁)	Pork, liver, whole grains, beans, nuts
Riboflavin (B ₂)	Dairy products, whole grains
Niacin (B ₃)	Meat, milk, eggs, nuts, poultry, whole grains
Pantothenic acid (B ₅)	Whole grains, meat, vegetables
Pyroxidine (B ₆)	Meat, fish, poultry, beans, grains, oranges
Biotin (H)	Eggs, milk, cereal
Folic Acid (B ₉)	Green leafy vegetables
Vitamin B ₁₂	Animal products
Vitamin C	Citrus fruits

Hydrosoluble vitamins

Deficiencies are rare for most of them

No toxicity from oral administration reported


Some of these vitamins are important in certain diseases or within certain diets

No vitamin C requirement for dogs and cats

Vitamin B1 functions

Review

The Role of Thiamine and Effects of Deficiency in Dogs and Cats

Georgia Kritikos, Jacqueline M. Parr  and Adronie Verbrugghe *


- Cofactor for pyruvate dehydrogenase
- NADH and nucleotides production
- Nervous system functions

- Cats require 2-4 times more thiamine than dogs

Vitamin B1 minimum/deficiency

- Formulation errors
- Sulfur dioxide
- Aflatoxin
- Thiaminase in (raw) fish
- Polyhydroxyphenols
- Cerebrocortical necrosis
- Polioencephalomalacia
- Hyperlactatemia
- Seizures, nystagmus, pray sign, ataxia, anorexia
- 5-250mg per day rapid recovery (1-12 weeks)

The Role of Thiamine and Effects of Deficiency in Dogs and Cats

Georgia Kritikos, Jacqueline M. Parr  and Adronie Verbrugghe *

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CASE REPORT

WILEY

Thiamine deficiency in a dog associated with exclusive consumption of boiled sweet potato (*Ipomoea batatas*): Serial changes in clinical findings, magnetic resonance imaging findings and blood lactate and thiamine concentrations

Joong-Hyun Song^{1,2}  | Dong-In Jung¹ 




Analysis of recipes of home-prepared diets for dogs and cats published in Portuguese

Vivian Pedrinelli¹, Márcia de O. S. Gomes² and Aulus C. Carciofi^{1*}

Thiamine 39 % for dogs; 80·7 % for cats)

Review

The Role of Thiamine and Effects of Deficiency in Dogs and Cats

Georgia Kritikos, Jacqueline M. Parr  and Adronie Verbrugghe *

Vitamin B1 minimum/deficiency

- Malnutrition / malabsorption (age, diarrhea)
- FeLV (receptor for uptake)
- Cardiac disease (malnutrition, diuretics, age)
- Kidney disease (urinary loss)

- Supplementation in dogs 50 -1250mg per day
Cats 20-300mg per day
- Neurological signs can remain present for 2 years

Vitamin B1 future directions/optimal use

Table 1. Recommendations for dietary thiamine set by the NRC (2006), AAFCO (2017), and FEDIAF (2017) for adult dogs and cats.


Organization	Nutritional Basis	Species	Minimum Adequate Intake	Minimum Recommended Allowance
NRC [12]	DM Basis ¹ (mg/kg DMB)	Cats	4.4	5.6
		Dogs	1.8	2.25
	Caloric Basis (mg/1000 kcal ME)	Cats	1.1	1.4
		Dogs	0.45	0.56
	Metabolic Body Weight	Cats ² (mg/kg ^{0.67})	0.11	0.14
		Dogs (mg/kg ^{0.75})	0.059	0.074
AAFCO [13]	DM Basis ¹ (mg/kg DMB)	Cats	-	5.6
		Dogs	-	2.25
	Caloric Basis (mg/1000 kcal ME)	Cats	-	1.4
		Dogs	-	0.56
FEDIAF [14]	DM Basis ¹ (mg/kg DMB)	Cats	-	4.4 ³ 5.9 ⁴
		Dogs	-	2.1 ⁵ 2.5 ⁶
	Caloric Basis (mg/1000 kcal ME)	Cats	-	1.10 ³ 1.47 ⁴
		Dogs	-	0.54 ⁵ 0.62 ⁶

AAFCO—Association of American Feed Control Officials; FEDIAF—Fédération Européenne de l'Industrie des Aliments Pour Animaux Familiers (European Pet Food Industry Federation); NRC—National Research Council; DMB—dry matter basis; ME—metabolisable energy; ¹ Based on a dietary energy density of 4000 kcal ME/kg; ² Based on a lean cat with an energy intake of 100 kcal x BW^{0.67}; ³ Based on a cat with a daily energy requirement of 100 kcal/kg^{0.67}; ⁴ Based on a cat with a daily energy requirement of 75 kcal/kg^{0.67}; ⁵ Based on a dog with a daily energy requirement of 110 kcal ME/kg^{0.75}; ⁶ Based on a dog with a daily energy requirement of 95 kcal ME/kg^{0.75}.



Review

The Role of Thiamine and Effects of Deficiency in Dogs and Cats

Georgia Kritikos, Jacqueline M. Parr  and Adronie Verbrugghe *

Vitamin B2 functions

- Precursor of FMN and FAD (flavins)
- Energy metabolism (respiratory chain)
- Co-factor in oxidation and reduction reactions
- Antioxidant function: glutathione reductase

Vitamin B2 minimum/deficiency

- Formulation errors
- Anorexia, weight loss
- Weakness, ataxia
- Coma, death
- Dermatitis
- Ocular lesions
- Fatty liver
- Testicular atrophy



Analysis of recipes of home-prepared diets for dogs and cats published in Portuguese

Vivian Pedrinelli¹, Márcia de O. S. Gomes² and Aulus C. Carciofi^{1*}

Riboflavin (65·8 % for dogs; 11·5 % for cats)

Vitamin B2 future directions/optimal use

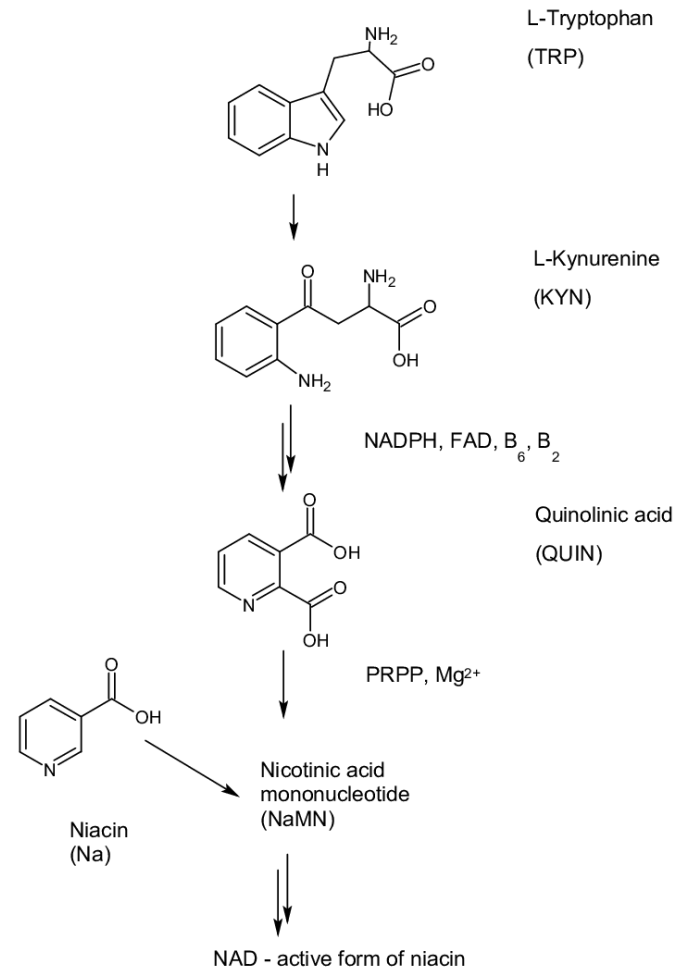
- NRC AI 1.05 RA 1.32 mg/1000kcal puppy/lactation
- NRC MR 1.05 RA 1.3 mg/1000kcal adult
- NRC AI 0.80 RA 1.0 mg/1000kcal kitten, adult, lactation

- FEDIAF 1.05-1.74 mg per 1000kcal dog
- FEDIAF 0.80-1.05 mg per 1000kcal cat

Vitamin B3 functions

- Precursor of NAD and NADP
- Energy metabolism (pentose phosphate pathway)
- Co-factor in oxidation and reduction reactions
- DNA repair

Nicotinamide synthesis from tryptophan



Cats have increased levels of picolinic carboxylase which converts Trp to acetyl CoA and CO₂

Vitamin B3 minimum/deficiency

- Formulation errors
- Black tongue (pellagra)
- GI inflammation and bloody discharge
- Anorexia and weight loss
- Oral cavity inflammation, ulceration, drooling, foetor

Vitamin B3 future directions/optimal use

- NRC AI 3.4 RA 4.25 mg/1000kcal dog
- NRC AI 8.0 RA 10.0 mg/1000kcal cat

- FEDIAF 3.44.74 mg per 1000kcal dog
- FEDIAF 8.010.05 mg per 1000kcal cat

Vitamin B5 functions

- Integral component of CoA
- Energy metabolism (glycolysis, β -oxidation, tricarboxylic acid cycle)
- Gluconeogenesis
- Fatty acid synthesis
- Synthesis of cholesterol and vitamin D
- Synthesis of porphyrin rings of hemoglobin
- Synthesis of acetylcholine

Vitamin B5 minimum/deficiency

- Formulation errors
- Sudden prostration, coma
- Rapid heart and respiratory rates
- Convulsions
- GI inflammation
- Fatty liver

Vitamin B5 future directions/optimal use

- NRC AI 3.0 RA 3.75 mg/1000kcal dog
- NRC MR 1.15 RA 1.44 mg/1000kcal cat

- FEDIAF 3.04.11 mg per 1000kcal dog
- FEDIAF 1.431.92 mg per 1000kcal cat

Vitamin B6 functions

- Coenzyme for many reactions, mostly for transamination
- Gluconeogenesis
- Erythrocyte function
- Niacin (B3) synthesis
- Nervous system, neurotransmitter synthesis
- Immune system
- Lipid metabolism
- Hormone regulation
- Gene expression

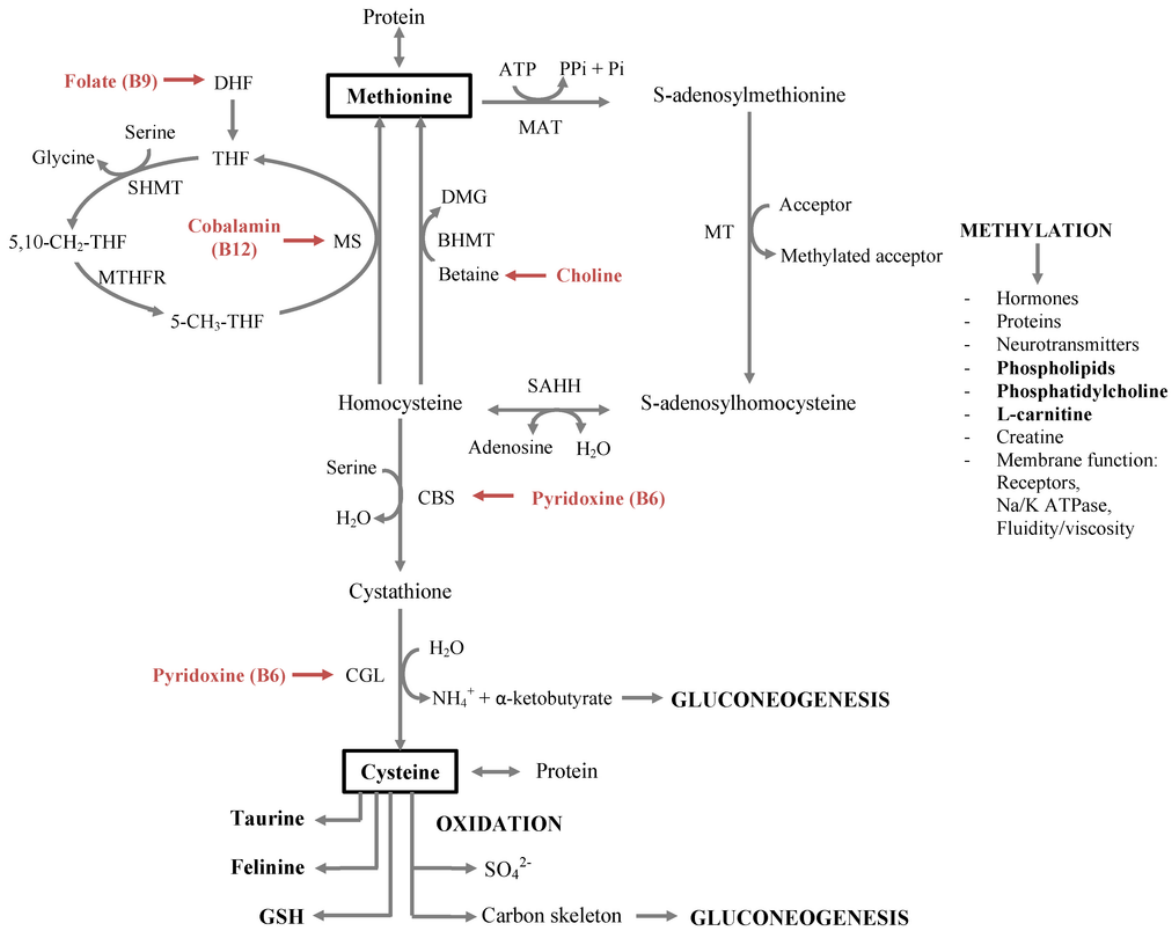
Review

Peculiarities of One-Carbon Metabolism in the Strict Carnivorous Cat and the Role in Feline Hepatic Lipidosis

Adronie Verbrugghe ^{1,*} and Marica Bakovic ²

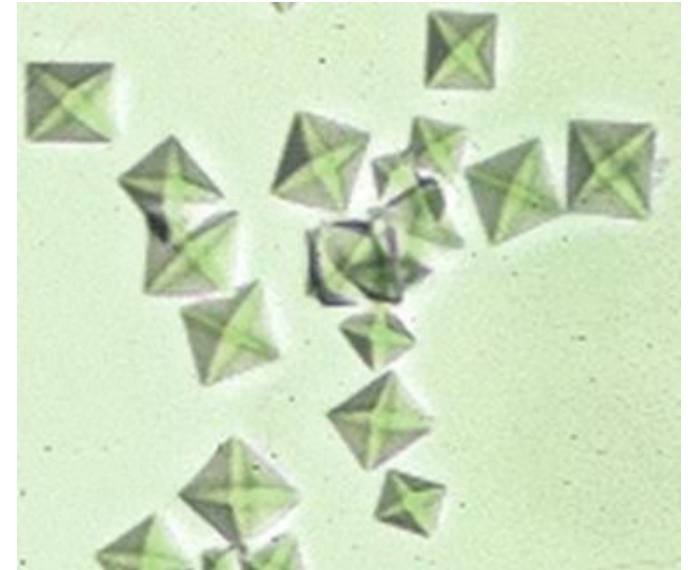
B-vitamins as co -factors

Especially in cats that are anorexic / hyporexic extra need to speed up recovery



Vitamin B6 minimum/deficiency

- Formulation errors
- Microcytic hypochromic anemia
- Ataxia
- Cardiac dilatation
- Congestion of various tissues
- Demyelination of peripheral nerves
- Seizures
- Kidney lesions, calcium oxalate formation



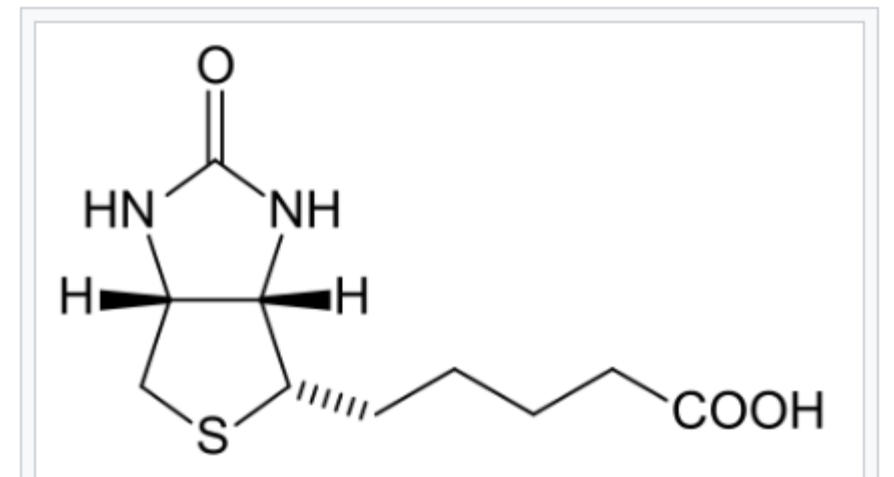
Vitamin B6 future directions/optimal use


- NRC AI 0.3 RA 0.375 mg/1000kcal dog
- NRC MR 0.5 RA 0.625 mg/1000kcal cat

- FEDIAF 0.30.42 mg per 1000kcal dog
- FEDIAF 0.630.83 mg per 1000kcal cat

Vitamin B7 functions

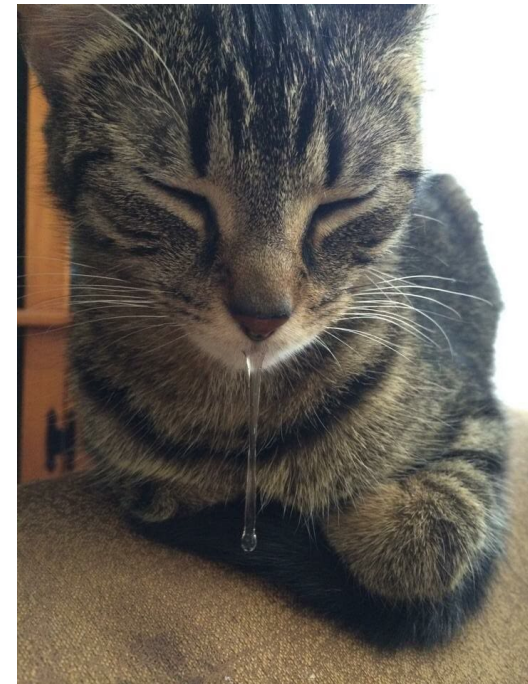
- Discovered when raw egg was fed
- Cofactor in 4 carboxylase reactions
- Gluconeogenesis
- Energy metabolism (tricarboxylic acid cycle)



Biotin - Avidin can bind up to four molecules of biotin simultaneously with a high degree of affinity and specificity 

Vitamin B7 minimum/deficiency

- Scurfy skin (dog)
- Alopecia, hypochromotrichia (cat)
- Hypersecretion (nasal, lacrimal, saliva)
- Anorexia and diarrhea



Vitamin B7 future directions/optimal use

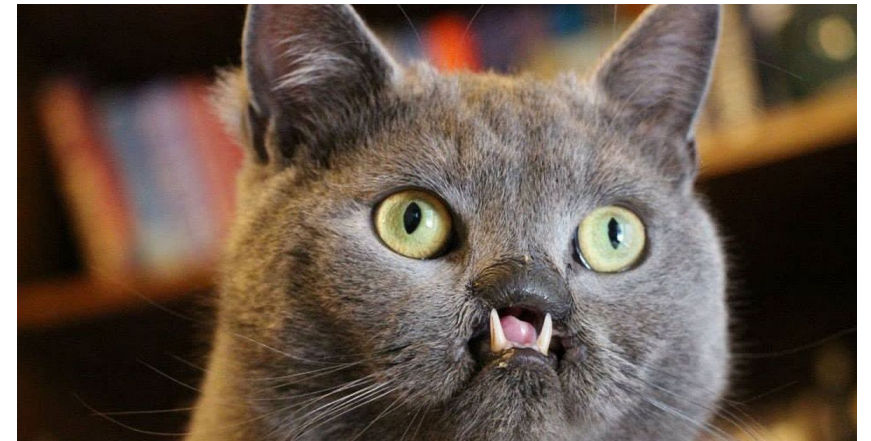
- NRC and FEDIAF microbial synthesis is sufficient
- Only need for supplementation when feeding raw egg white
- 2µg per kg body weight in adult dogs
- 4µg per kg body weight in growing dogs
- 1.5µg per (kg body weight)^{0.67} in cats

Vitamin B9/11 functions

- Cofactor
- Amino acid and nucleotide metabolism
- Disposal of one-carbon units
- Mitochondrial protein synthesis
- Hematopoiesis

Vitamin B9/11 minimum/deficiency

- Low hematocrit and hemoglobin
- Anorexia
- Cleft palate
- Neural tube defects (humans)



Vitamin B9/11 excess

- No adverse effects
- Can be an indication of small intestinal bacterial overgrowth

Vitamin B9/11 future directions/optimal use

- NRC AI 54 RA 68 $\mu\text{g}/1000\text{kcal}$ dog
- NRC MR 150 RA 188 $\mu\text{g}/1000\text{kcal}$ cat

- FEDIAF54-74.7 μg per 1000kcal dog
- FEDIAF188-253 μg per 1000kcal cat

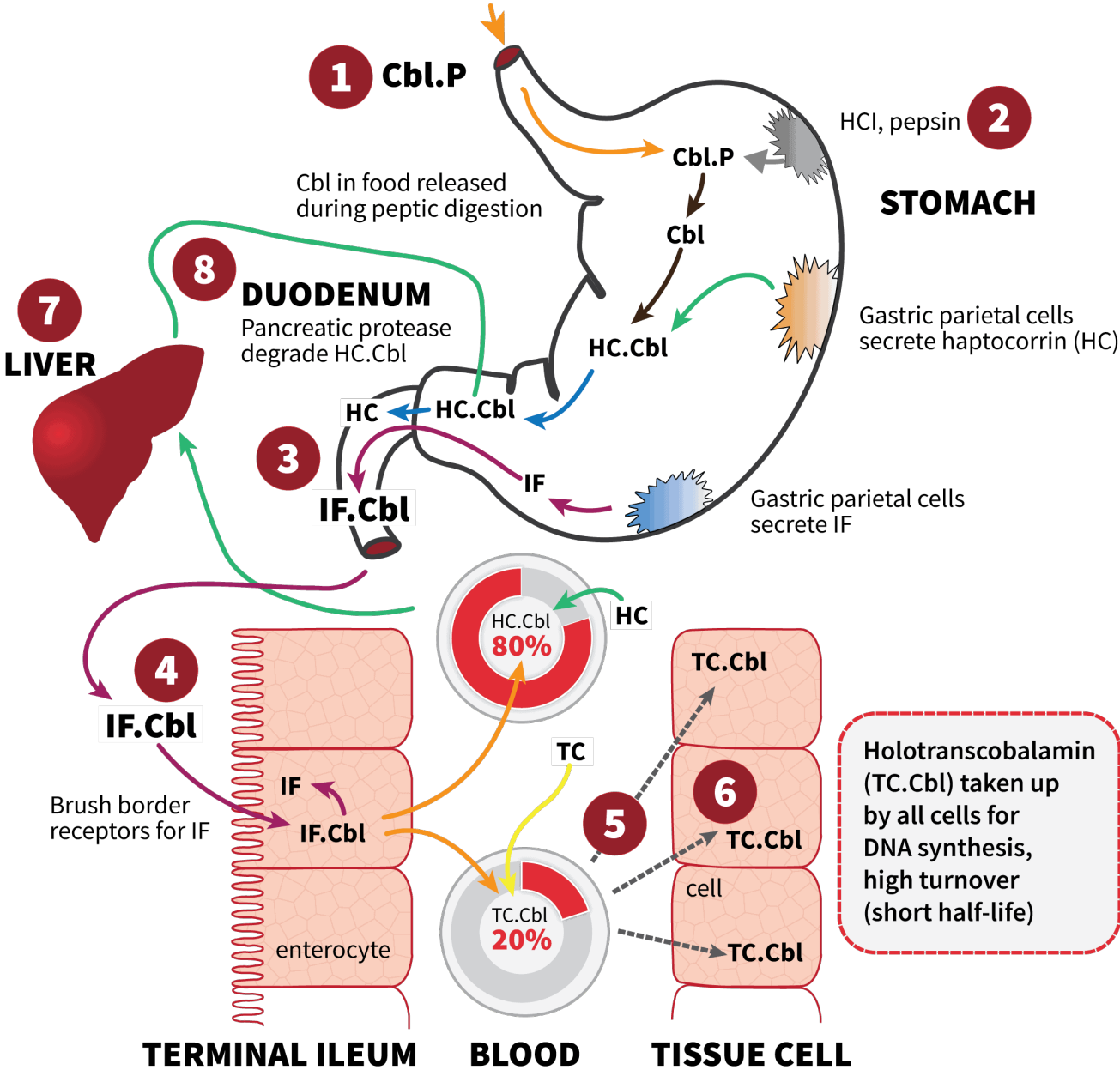
Vitamin B12 functions

- Can only be synthesized by microorganisms
- Present in animal protein and fermentation products
- Coenzyme
- Main function in hematopoiesis

Vitamin B12 minimum/deficiency

- Low levels B12 combined with high B9/11 in SIBO
- Neutropenia with hypersegmentation
- Anemia
- Megaloblastic changes of bone marrow
- Inappetence
- Diarrhea
- GI inflammation
- Deficiency in case of pancreatic insufficiency

VITAMIN B12 ABSORPTION



B12 deficiency in 40% of cats with CE

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STANDARD ARTICLE

Journal of Veterinary Internal Medicine

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ACVIM

American College of
Veterinary Internal Medicine

Anemia, iron deficiency, and cobalamin deficiency in cats with chronic gastrointestinal disease

Adam Hunt¹ | Maria C. Jugan² 

B12 supplementation in dogs with CE (0.25 -1.4mg)

The Veterinary Journal 232 (2018) 27–32



Contents lists available at [ScienceDirect](#)

The Veterinary Journal

journal homepage: www.elsevier.com/locate/tvjl



Original Article

Comparison of efficacy of oral and parenteral cobalamin supplementation in normalising low cobalamin concentrations in dogs: A randomised controlled study

L. Toresson^{a,b,*}, J.M. Steiner^c, P. Razdan^d, E. Spodsberg^b, G. Olmedal^b, J.S. Suchodolski^c, T. Spillmann^a



B12 deficiency and effect of supplementation in a dog with CE



Picture 1A. Before treatment
After 6 months diarrhoea

Picture 1B. After treatment
6 months after start of treatment

Hypochromotrichia

Vitamin B12 future directions/optimal use

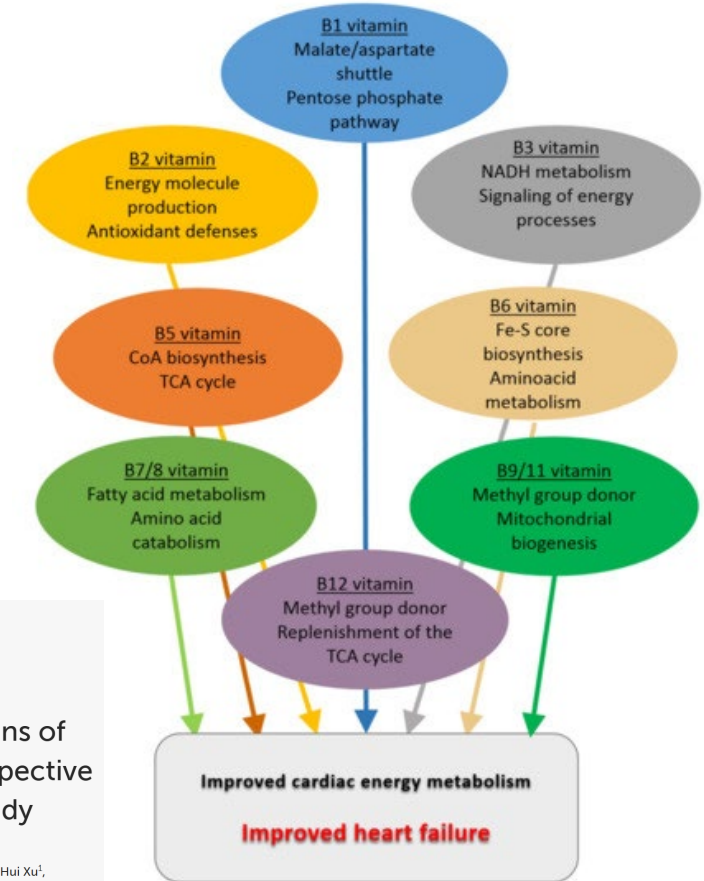
- NRC AI 7 RA 8.75 $\mu\text{g}/1000\text{kcal}$ dog
- NRC AI 4.5 RA 5.6 $\mu\text{g}/1000\text{kcal}$ cat
- FEDIAF 79.68 μg per 1000kcal dog
- FEDIAF 4.45.87 μg per 1000kcal cat

Vitamin C

- Catalyst
- Cofactor (electron donor for metal ions)
- Hormone synthesis, hormone activation
- Collagen synthesis
- In low levels antioxidant, in high levels prooxidant
- Regeneration of vitamin E in low levels, higher need for vitamin E in high levels
- May predispose for CaOx, can lower urine pH slightly

Therapeutic use of B -complex

- Cardiac disease
- Cognitive decline
- Critical care
- Pain (humans)



ORIGINAL RESEARCH article

Front. Nutr., 12 December 2018
Sec. Neuroenergetics, Nutrition and Brain Health
Volume 5 - 2018 | <https://doi.org/10.3389/fnut.2018.00127>

Efficacy of a Therapeutic Diet on Dogs With Signs of Cognitive Dysfunction Syndrome (CDS): A Prospective Double Blinded Placebo Controlled Clinical Study

Yuanlong Pan^{1*}, Gary Landsberg², Isabelle Mougeot², Stephanie Kelly³, Hui Xu¹,
Sandeep Bhatnagar¹, Cari L. Gardner¹ and Norton W. Milgram²



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