Vitamin Chart

Name	Function	Deficiency signs	Extra Clues	Toxicity/disease/other
	-Required by all animals -Exists as retinol, retinal, retinoic acid, and retinyl palmitate -Required for vision (rhodopsin → night vision) -Maintains epithelial tissues -Supports bone growth -Antioxidant role -First fat-soluble vitamin discovered	-Night blindness -Keratinization of epithelial cells -Increased respiratory infections -Reproductive problems: *Females: abortions, retained placentas, low calf vigor, blind calves *Males: decreased libido, poor sperm motility, degeneration	-Main precursor: beta-carotene in plants -Conversion happens in small intestine mucosal cells -Absorption is energy dependent and transported to liver via lymphatics -Stored in Kupffer cells of the liver -All-trans form has highest biological activity	Safe upper level: ● Non-ruminants: 4–10 × requirement ● Ruminants: 30–50 × requirement Toxicity usually at ~1000 × requirement 1,000,000 IU can be lethal in humans
	-Raises blood calcium and phosphorus -Increases Ca & P absorption from the gut -Increases Ca & P release from bone -Stimulates Ca-binding protein -Helps phosphorus absorption in small intestine	● Poor skeletal growth ● Inadequate bone mineralization ● Rickets (young animals) ● Osteomalacia (adults) ● Requirements rise with growth rate ● True deficiency is rare in cattle due to sunlight exposure	-Vitamin D2 = ergosterol in plants -Vitamin D3 = 7-dehydrocholesterol in animals -Sunlight activated -Active form is formed in liver and kidneys -Uptake is rapid in the duodenum, but most absorbed in jejunum and ileum	Calcification of soft tissues (kidney, liver, muscle) Very high doses (>1,000,000 IU/day) used briefly to prevent milk fever Excess levels can reduce feed intake
	-Antioxidant — protects lipids in cell membranes from peroxidation -Prevents formation of free-radical peroxides that damage cells -Supports immune function (helps increase antibody production) -Works with selenium;	-Reproductive failure -Cell membrane damage (deranged cell permeability) -Muscle lesions → myopathy / muscular dystrophy -White muscle disease -Mulberry heart disease (heart muscle degeneration) -Liver necrosis -Requirement increases when dietary PUFAs increase (more oxidation risk)	-First identified as fat-soluble factor needed for normal reproduction in rats -Tocopherols absorbed in the jejunum by passive diffusion -Form micelles with bile salts for absorption -Placental transfer is very inefficient -Expensive and unstable	● Very little toxicity reported ● Generally considered the **most tolerable** of the fat-soluble vitamins

Vitamin Chart

	Essential for **blood clotting**
	
	Acts as a **cofactor** for enzymes involved in **prothrombin** production
		• **Increased clotting time**
		• Higher risk of **internal bleeding**
		• Deficiency often linked to:
		  ○ Feed additives that inhibit Vit K–producing bacteria
		  ○ Housing systems (slotted floors, low manure contact) that reduce bacterial exposure
			Forms:
			• **K1 (phylloquinone)** — plant-derived
			• **K2 (menaquinone)** — produced by microbes
			• **K3 (menadione)** — synthetic form widely used
			
			Significant **bacterial synthesis in the rumen** and some in large intestine
				No toxicity mentioned for Vitamin K
				
				Sweet Clover Disease:
				• Moldy sweet clover hay contains **dicoumarol**, a Vitamin K antagonist
				• Dicoumarol binds the same enzyme as Vitamin K but **does not catalyze the reaction**
				• Leads to **internal bleeding** and death in cattle
				• Dicoumarol and **Warfarin** (another antagonist) are active ingredients in rat poisons

	Important in **decarboxylation reactions** (e.g., pyruvate → acetaldehyde + CO_2) High in **whole grains**	↑ **Blood pyruvic & lactic acid** **Anorexia** **Polyneuritis** (chickens: “star-gazing”/head retraction) **Beriberi** in humans (numbness, weakness, enlarged heart)	Thiamine Pigs store in tissues more than other species	**PEM (Polioencephalomalacia)** -Seen in feedlot cattle after sudden diet changes → acidosis -Rumen bacteria produce **thiaminase I & II** → thiamin destruction -Causes **blindness, convulsions, death** **-**Treated with **IV thiamin** **-**High dietary sulfur risk factor
	Component of **FAD** Involved in **energy metabolism** & **electron transfer**	**Poor growth** **Poor appetite**	Riboflavin	Requirement linked to energy metabolism & growth rate

Vitamin Chart

	• Structural component of **NAD** • Needed for **energy transfer**, Krebs cycle, oxidative phosphorylation	**Slow growth**, poor appetite **Pellagra**: dermatitis, diarrhea Niacin in grains is **unavailable to non-ruminants** Can be synthesized from **tryptophan**	Niacin	Supplementation helps: • Dairy cattle (**6–12 g/day**) — reduces subclinical ketosis • 6 g/day may increase milk production • Useful in high-corn diets (feedlot, dairy, young calves)
	Component of **Coenzyme A** Important in **energy metabolism** (Krebs cycle)	**"Goose-stepping" gait** (nerve damage) **Hair loss** **Enteritis**	Pantothenic acid	
	Coenzyme in protein and nitrogen metabolism Required for **transamination reactions**	• **Nervous system disorders**: convulsions, myelin sheath issues	Pyridoxine	Low bioavailability in grains
	Cofactor for several **Krebs cycle enzymes** Important for **gluconeogenesis**	Scaly dermatitis	Biotin	**Avidin** in raw egg whites binds biotin & reduces availability
	Methyl donor (CH_3) Needed to produce **SAM** SAM required for: • **DNA synthesis** • **Blood cell formation**	anemia	Folic acid	• Requirement increases during **pregnancy**

Vitamin Chart

	Converts precursors to **TCA cycle intermediates** Important in **propionate metabolism** Closely linked with **folic acid**		Cyanocobalamin	• Requires **Intrinsic Factor (IF)** for absorption • B12–IF complex absorbed in small intestine • Cattle need **cobalt** for rumen microbes to synthesize B12
			Adenine	
			Inositol	
			Para Amino Benzoic Acid	
			Salicyclic acid	
	Involved in **nerve transmission** (acetylcholine) Component of **phospholipids** & cell membranes Involved in **fat metabolism**			Similar to B-vitamins Made in the liver Required in **large amounts**, especially for ruminants **Choline chloride is hygroscopic** → absorbs moisture → reduces vitamin stability
	Required for **collagen synthesis** and metabolism	**Scurvy** (in species that require)		Only **humans, guinea pigs, and apes** require it Domestic livestock **do NOT** have a dietary requirement

Vitamin Bank:

Vitamin D, Vitamin A, Vitamin K, Vitamin E, Vitamin C, Choline, B1, B2, B3, B4, B5, B6, B7, B8, B9, B10, B11, B12,