



DSM Vitamin Supplementation Guidelines 2016 for animal nutrition.

Check vitamin levels in animal feed. Always.

HEALTH • NUTRITION • MATERIALS



BROILERS

TURKEYS

LAYERS &
OTHER POULTRY

SWINE

RUMINANTS

FISH & SHRIMPS

HORSES & OTHERS



COMPANION
ANIMALS

OUR VISION
ON VITAMINS



BROILERS

BROILERS ⁽¹⁾

Category/Phase	Duration	Vit. A ⁽²⁾	Vit. D ₃ ⁽²⁾	25OHD ₃ (Hy•D) ⁽²⁾	Vit. E ⁽⁴⁾	Vit. K ₃ (menadione)	Vit. B ₁	Vit. B ₂	Vit. B ₆	Vit. B ₁₂ ⁽⁶⁾	Niacin	d-Panto- thenic acid	Folic acid	Biotin	Vit. C ⁽⁹⁾⁽¹⁰⁾	Choline
		I.U.	I.U.	mg	mg	mg	mg	mg	mg	mg	mg	mg	mg	mg	mg	mg
 Broilers Starter	1-10 days	12000-15000	4000-5000	0,069	150-200 ⁽⁵⁾	3-4	3-4	8-10	4-6	0,020-0,040	60-80	15-20	2-2,5	0,25-0,40	100-200	400-700
Grower	11-24 days	10000-12500	4000-5000	0,069	50-100 ⁽⁶⁾⁽⁷⁾	3-4	2-3	7-9	4-6	0,020-0,030	60-80	12-18	2-2,5	0,25-0,40	100-200	400-700
Finisher	25 dd-market	10000-12500	4000-5000	0,069	50-100 ⁽⁶⁾⁽⁷⁾	3-4	2-3	6-8	4-6	0,020-0,030	50-80	10-15	2-2,5	0,25-0,40	100-200	400-600
 Broiler breeders Starter/Grower (Pullets)	0-18 weeks	10000-12000	3000-5000	0,069	100-150 ⁽⁵⁾	3-5	2-3,5	8-10	4-6	0,020-0,030	30-60	13-15	1,5-2,5	0,25-0,40	100-150	350-700
Layers and male breeders	19 weeks-end	12000-15000	3000-5000	0,069 ⁽³⁾	100-150 ⁽⁶⁾	5-7	3-3,5	12-16	4-6	0,030-0,040	50-60	15-25	2-4	0,25-0,40	100-150	350-700

⁽¹⁾ Added per kg air-dry feed ⁽²⁾ Local legal limits need to be observed ⁽³⁾ Add 60 mg/kg CAROPHYLL[®] red to improve hatchability. MaxiChick[™] (Hy-D[®] 1,25% and CAROPHYLL[®] red) is a DSM Nutritional Products Patent and Trademark.

⁽⁴⁾ When dietary fat is higher than 3% then add 5 mg/kg feed for each 1% dietary fat ⁽⁵⁾ For optimum immune function increase level up to 300 mg/kg ⁽⁶⁾ Under heat stress conditions increase level up to 200 mg/kg ⁽⁷⁾ For optimum meat quality increase level up to 200 mg/kg ⁽⁸⁾ Use upper level as reference for animal protein free diets and when cobalt is supplemented at very low levels or removed ⁽⁹⁾ Recommended under heat stress condition and to enhance reproductive performance in breeders ⁽¹⁰⁾ Use ROVIMIX[®] STAY-C[®]35 for reducing loss during processing

OPTIMUM VITAMIN NUTRITION



TURKEYS

TURKEYS ⁽¹⁾

Category/Phase	Duration	Vit. A ⁽²⁾	Vit. D ₃ ⁽²⁾	250HD ₃ (Hy•D) ⁽²⁾	Vit. E ⁽⁴⁾	Vit. K ₃ (menadione)	Vit. B ₁	Vit. B ₂	Vit. B ₆	Vit. B ₁₂ ⁽⁸⁾	Niacin	d-Panto- thenic acid	Folic acid	Biotin	Vit. C ⁽⁹⁾⁽¹⁰⁾	Choline
		I.U.	I.U.	mg	mg	mg	mg	mg	mg	mg	mg	mg	mg	mg	mg	mg
 Turkeys Starter	0-6 weeks	12000-15000	4000-5000	0,092	150-200 ⁽⁵⁾	4-5	4,5-5	15-20	6-7	0,040-0,050	100-150	30-35	4-6	0,25-0,40	100-200	1000-1200
Grower	7-12 weeks	10000-12000	3000-5000	0,092	60-80 ⁽⁶⁾	3-4	3-5	10-15	5-7	0,030-0,040	80-100	20-25	2-3	0,25-0,30	100-200	500-1000
Finisher 1	13-18 weeks	8000-10000	3000-4000	0,092	30-50 ⁽⁶⁾⁽⁷⁾	3-4	3-4	8-10	3-6	0,020-0,030	60-80	15-20	2-2,5	0,20-0,25	100-200	400-600
Finisher 2	18 wks-market	6000-9000	3000-4000	0,092	30-50 ⁽⁶⁾⁽⁷⁾	3-4	2-3	8-10	3-6	0,015-0,025	50-60	15-20	2-2,5	0,20-0,25	100-200	400-600
 Turkey breeders Starter	0-6 weeks	12000-14000	4000-5000	0,092	100-150 ⁽⁵⁾	4-5	4,5-5	15-20	6-7	0,040-0,050	100-150	30-35	4-6	0,40-0,60	100-200	1000-1200
Grower	7-29 weeks	8000-10000	4000-5000	0,092	60-80 ⁽⁶⁾	2-4	2-3	10-15	6-7	0,030-0,040	60-80	25-30	2-3	0,40-0,60	100-200	1000-1200
Layers and male breeders	Laying phase	12000-14000	4000-5000	0,092 ⁽³⁾	100-150 ⁽⁶⁾	4-5	4-5	15-20	6-7	0,040-0,050	80-120	30-35	4-6	0,40-0,60	100-200	500-1000

⁽¹⁾ Added per kg air-dry feed ⁽²⁾ Local legal limits need to be observed ⁽³⁾ Add 60 mg/kg CAROPHYLL[®] red to improve hatchability. MaxiChick[™] (Hy-D[®] 1,25% and CAROPHYLL[®] red) is a DSM Nutritional Products Patent and Trademark.






⁽⁴⁾ When dietary fat is higher than 3% then add 5 mg/kg feed for each 1% dietary fat ⁽⁵⁾ For optimum immune function increase level up to 300 mg/kg ⁽⁶⁾ Under heat stress conditions increase level up to 200 mg/kg ⁽⁷⁾ For optimum meat quality increase level up to 200 mg/kg ⁽⁸⁾ Use upper level as reference for animal protein free diets and when cobalt is supplemented at very low levels or removed ⁽⁹⁾ Recommended under heat stress condition and to enhance reproductive performance in breeders ⁽¹⁰⁾ Use ROVIMIX[®] STAY-C[®]35 for reducing losses during processing

OPTIMUM VITAMIN NUTRITION



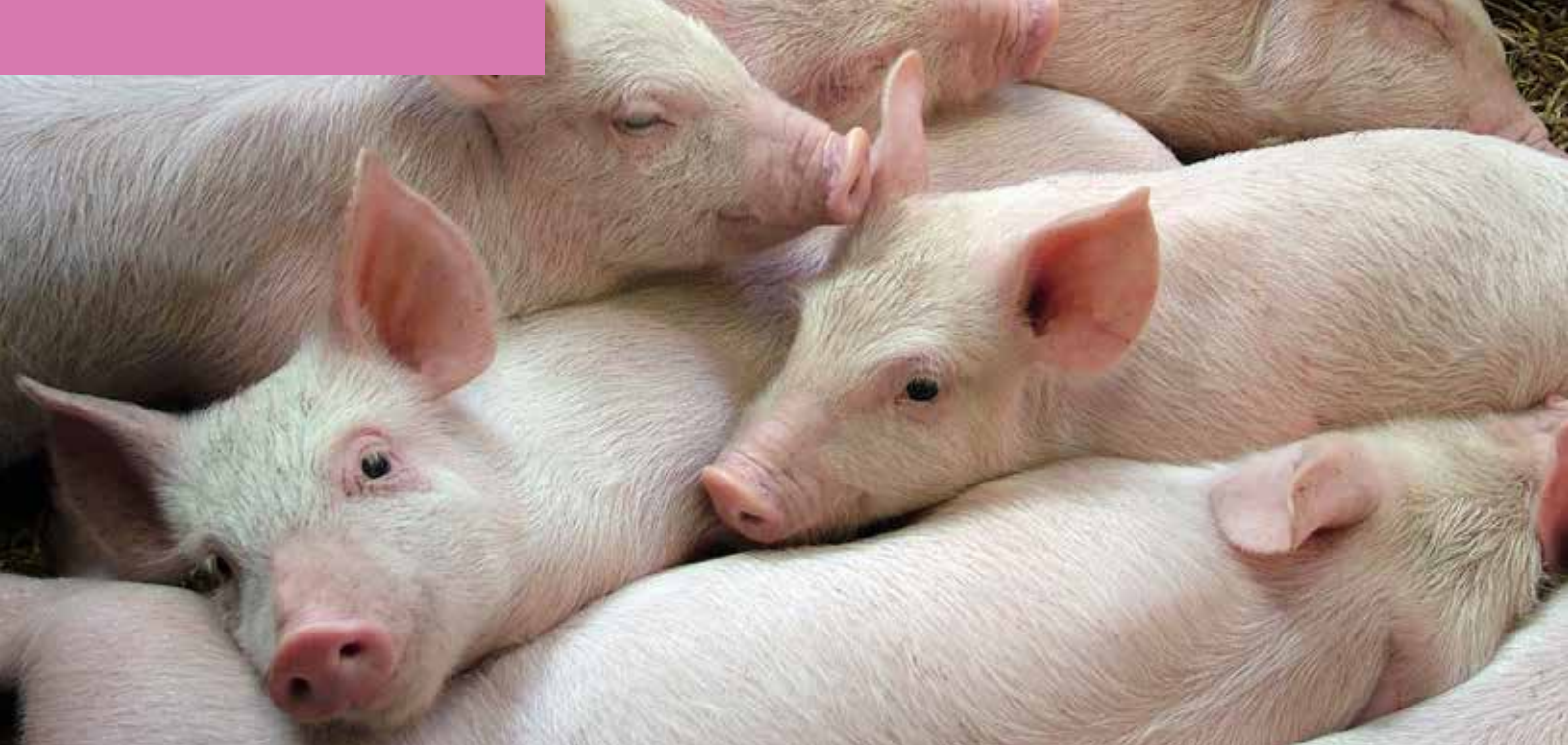
LAYERS & OTHER POULTRY

LAYERS & OTHER POULTRY ⁽¹⁾

Category/Phase	Duration	Vit. A ⁽²⁾	Vit. D ₃ ⁽²⁾	25OHD ₃ (Hy-D) ⁽²⁾	Vit. E ⁽⁴⁾	Vit. K ₃ (menadione)	Vit. B ₁	Vit. B ₂	Vit. B ₆	Vit. B ₁₂ ⁽⁷⁾	Niacin	d-Panto- thenic acid	Folic acid	Biotin	Vit. C ⁽⁸⁾⁽⁹⁾	Choline
		I.U.	I.U.	mg	mg	mg	mg	mg	mg	mg	mg	mg	mg	mg	mg	mg
 Hens and Duck Layers Starter (Pullets)	0-10 weeks	12000-13000	3000-4000	0,069	50-70 ⁽⁵⁾	3-3,5	2-2,5	6-7	4,5-5,5	0,025-0,030	50-60	15-17	1-1,5	0,15-0,20	100-150	200-400
Rearing (Pullets)	10 wks-2% lay	10000-12000	3000-4000	0,069	30-35	3-3,5	2-2,5	5-6	3-5	0,020-0,025	30-60	12-15	1-1,5	0,10-0,15	100-150	200-400
Layers	Laying phase	8000-12000	3000-4000	0,069	20-30 ⁽⁶⁾	2,5-3	2,5-3	5-7	3,5-5	0,015-0,025	30-50	8-12	1-1,5	0,10-0,15	100-200	300-500
 Layers breeders Pullets, layers and male breeders	0 weeks to end	10000-15000	3000-4500	0,069 ⁽³⁾	50-100 ⁽⁵⁾⁽⁶⁾	2-5	2,5-3,5	10-12	5-6	0,020-0,040	45-60	15-20	2-3	0,25-0,40	150-200	300-500
 Ducks and Geese		12000-15000	3000-5000	0,069	40-80	3-5	2-3	5-7	5-7	0,020-0,040	60-80	10-15	1-2	0,20-0,25	100-200	300-500
 Partridges, quails and pheasants		12000-13500	3000-4000	0,069	50-80	2-4	2-4	5-7	4-6	0,030-0,050	50-80	15-25	1,5-2	0,20-0,25	100-200	400-600
 Ostrich and emu		12000-16000	3000-4000	0,069	40-60	2-4	3-5	10-20	6-8	0,050-0,100	80-100	12-20	2-4	0,20-0,35	200-250	600-800



⁽¹⁾ Added per kg air-dry feed ⁽²⁾ Local legal limits need to be observed ⁽³⁾ Add 60 mg/kg CAROPHYLL® red to improve hatchability. MaxiChick™ (Hy-D® 1,25% and CAROPHYLL® red) is a DSM Nutritional Products Patent and Trademark.

⁽⁴⁾ When dietary fat is higher than 3% then add 5 mg/kg feed for each 1% dietary fat ⁽⁵⁾ For optimum immune function increase level up to 100 mg/kg in Layers Starter and up to 150 mg/kg in Breeders ⁽⁶⁾ Under heat stress conditions increase level up to 200 mg/kg ⁽⁷⁾ Use upper level as reference for animal protein free diets and when cobalt is supplemented at very low levels or removed ⁽⁸⁾ Recommended under heat stress condition and to enhance reproductive performance in breeders ⁽⁹⁾ Use ROVIMIX® STAY-C®35 for reducing loss during processing



SWINE

SWINE ⁽¹⁾

Category/Phase	Duration	Vit. A ⁽²⁾	Vit. D ₃ ⁽²⁾	250HD ₃ (Hy•D) ⁽²⁾	Vit. E ⁽³⁾	Vit. K ₃ (menadiione)	Vit. B ₁	Vit. B ₂	Vit. B ₆	Vit. B ₁₂ ⁽⁷⁾	Niacin	d-Panto thenic acid	Folic acid	Biotin	Vit. C ⁽⁸⁾⁽⁹⁾	Choline	β-carotene
		I.U.	I.U.	mg	mg	mg	mg	mg	mg	mg	mg	mg	mg	mg	mg	mg	mg
 Fattening pigs																	
Pre-starter	<5 kg	10000-20000	1800-2000	0,05	100-150 ⁽⁴⁾	8-10	3,5-5,5	10-15	6-8	0,05-0,07	60-80	30-50	1,5-3	0,30-0,50	200-250	500-800	
Starter	5-30 kg	10000-15000	1800-2000	0,05	100-150	5-6	3-5	10-15	6-8	0,04-0,06	35-55	25-45	1,5-2,5	0,30-0,50	100-200	250-400	
Grower	30-70 kg	7000-10000	1500-2000	0,05	60-100 ⁽⁵⁾	2-4	2-3	7-10	2,5-4,5	0,03-0,05	20-40	25-45	1-1,5	0,15-0,30		150-300	
Finisher	70 kg to market	5000-8000	1000-1500	0,05	60-100 ⁽⁵⁾	2-4	1-2	6-10	2-3,5	0,03-0,05	20-40	25-45	0,5-1	0,10-0,20		100-200	
 Breeders																	
Replacement gilts		10000-12500	1800-2000	0,05	80-100	2-3,5	1-2	6-10	5-8	0,03-0,05	25-35	15-30	3,5-5,5	0,30-0,50	200-300	250-500	
Sows	Gestation/ Lactation	10000-15000	1500-2000	0,05	100-150 ⁽⁶⁾	4,5-5	2-2,5	6-10	3,5-5,5	0,03-0,05	30-45	35-40	3,5-5,5	0,50-0,80	200-300	500-800	300 ⁽¹⁰⁾
Boars		10000-15000	1500-2000	0,05	100-150	4,5-5	1-2	6-10	3,5-5,5	0,03-0,05	30-45	20-30	3,5-5,5	0,50-0,80	200-500	500-800	








⁽¹⁾ Added per kg air-dry feed ⁽²⁾ Local legal limits need to be observed ⁽³⁾ When dietary fat is higher than 3% then add 5 mg/kg feed for each 1% dietary fat ⁽⁴⁾ For optimum immune function increase level up to 250 mg/kg ⁽⁵⁾ For optimum meat quality increase level up to 250 mg/kg for 90 to 120 days before slaughter ⁽⁶⁾ For optimum piglet health increase level up to 250 mg/kg during late pregnancy and lactation ⁽⁷⁾ Use upper level when cobalt is supplemented at very low levels or removed ⁽⁸⁾ Recommended in stress condition and to enhance reproductive performance in breeders ⁽⁹⁾ Use ROVIMIX® STAY-C® 35 for reducing losses during processing ⁽¹⁰⁾ For improved sow fertility the suggested level must be fed **per animal per day** immediately after weaning until confirmed conception

OPTIMUM VITAMIN NUTRITION



RUMINANTS

RUMINANTS






Category/Phase	Vit. A ⁽⁵⁾	Vit. D ₃ ⁽⁵⁾	Vit. E	Vit. K ₃ (menadiene)	Vit. B ₁	Vit. B ₂	Vit. B ₆	Vit. B ₁₂	Niacin	d-Panto- thenic acid	Folic acid	Biotin	Vit. C	Choline	β-carotene
	I.U.	I.U.	mg	mg	mg	mg	mg	mg	mg	mg	mg	mg	mg	mg	mg
 Calves, milk replacer⁽¹⁾ 0-3 months	20000-32000	1400-1800	100-150	1-1,5	2,5-5	2,5-4,5	2,5-4,5	0,04-0,08	9-18	7-9	0,2-0,3	0,05-0,10	250-500	500-750	100 ⁽¹³⁾
 Heifers⁽²⁾ Rearing	20000-40000	2500-4000	500									10-20 ⁽¹¹⁾			300-500 ⁽¹⁴⁾
	6-4 wks before calving	60000-75000	15000-20000	1000-3000								20 ⁽¹¹⁾			500-1000 ⁽¹⁵⁾
 Beef cattle⁽²⁾ Growing	25000-50000	6000-9000	200-300		60-250 ⁽⁹⁾							10-20 ⁽¹¹⁾			
	Fattening & finishing	40000-80000	5000-7000	500-2000 ⁽⁶⁾		60-250 ⁽⁹⁾						10-20 ⁽¹¹⁾			
 Beef cows⁽²⁾	40000-70000	5000-10000	300-500									20 ⁽¹¹⁾			300-500 ⁽¹⁴⁾
 Dairy cows⁽²⁾ Far off & Close-up ⁽³⁾	80000-100000	25000-30000	1000-4000 ⁽⁷⁾									20 ⁽¹²⁾			500-1000 ⁽¹⁶⁾
	Transition ⁽⁴⁾	80000-100000	25000-30000	1000-4000 ⁽⁷⁾					5000-10000 ⁽¹⁰⁾			20 ⁽¹²⁾			500-800 ⁽¹⁷⁾
	Lactation	100000-150000	25000-40000	600-1000 ⁽⁸⁾					5000-10000 ⁽¹⁰⁾			20 ⁽¹²⁾			300-500 ⁽¹⁸⁾
 Breeding bulls⁽²⁾	50000-80000	5000-10000	300-500									20 ⁽¹¹⁾			
 Sheep & Goats⁽²⁾	5000-10000	400-600	200-600									5 ⁽¹²⁾			30-50

⁽¹⁾ Added per kg Calf Milk Replacer powder ⁽²⁾ Supplementary amount per animal per day ⁽³⁾ Far off: from 8 to 3 weeks before calving; Close-up: from 3 weeks before calving to calving ⁽⁴⁾ Transition: from 4-3 weeks before calving to 3-4 weeks after calving ⁽⁵⁾ Local legal limits need to be observed ⁽⁶⁾ Upper level for improved color shelf-life, 100 to 120 days pre-slaughter ⁽⁷⁾ Upper level from 21 days pre-partum until 28 days post-partum ⁽⁸⁾ Upper level for optimum udder health ⁽⁹⁾ Upper level for cattle on high concentrate rations ⁽¹⁰⁾ From 2 weeks before parturition until peak lactation ⁽¹¹⁾ For optimum hoof health and optimum meat marbling ⁽¹²⁾ For optimum hoof health and milk yield ⁽¹³⁾ For 2 weeks after colostral period ⁽¹⁴⁾ 6-8 weeks before 1st insemination/mating when intake of green forage is low ⁽¹⁵⁾ Lower level 8 weeks before 1st calving; upper level 4 weeks before 1st calving when intake of green forage is low ⁽¹⁶⁾ Lower level during entire dry period (Far off and Close-up); upper level 3-4 weeks before calving (close-up only) ⁽¹⁷⁾ 500-800 mg from 3 to 4 weeks before calving and 300-500 mg from 4 to 6 week after calving ⁽¹⁸⁾ Dry and fresh: beginning during the dry period until pregnancy is confirmed



FISH & SHRIMPS

FISH & SHRIMPS ⁽¹⁾

Category/Phase	Vit. A	Vit. D ₃	Vit. E	Vit. K ₃ (menadione)	Vit. B ₁	Vit. B ₂	Vit. B ₆	Vit. B ₁₂	Niacin	d-Panto- thenic acid	Folic acid	Biotin	Vit. C ⁽⁶⁾	Choline	Astaxanthin
	I.U.	I.U.	mg	mg	mg	mg	mg	mg	mg	mg	mg	mg	mg	mg	mg
 Salmon / Trout⁽²⁾	4000-8000	2500-3500	200-400 ⁽⁵⁾	8-12	15-30	25-40	20-35	0,05-0,08	150-200	40-60	10-15	1,0-1,2	150-250 ⁽⁷⁾	500-1000	50-100 ⁽⁸⁾
 Warm-water fish⁽²⁾ Carp/Tilapia/Cat-fish	8000-11000	1500-2000	100-300	5-10	10-20	15-20	15-25	0,02-0,05	80-120	40-50	4-7	0,5-1,0	150-250	600-1000	
 Eels⁽²⁾	8000-12000	1500-2000	150-300	3-6	15-25	20-30	10-15	0,10-0,20	80-120	50-60	4-6	0,3-0,5	150-300	800-1200	
 Seabream / Seabass⁽²⁾	8000-12000	1700-2200	200-400	8-12	20-30	20-30	20-25	0,10-0,20	100-140	50-100	4-6	0,8-1,0	150-250	600-1000	
 Shrimp⁽³⁾	7000-12000	2500-6500 ⁽⁴⁾	150-300	40-60	50-100	40-80	50-120	0,02-0,05	100-250	100-180	10-20	1,0-2,0	250-500	400-600	15-80



⁽¹⁾ Added per kg air-dry feed ⁽²⁾ Amount to be increased by 30% for fry and broodstock ⁽³⁾ At low stock density (<10pl/m²) the lower levels are recommended ⁽⁴⁾ upper level for low salinity rearing ⁽⁵⁾ Additional 200 mg/kg may be required to optimise flesh quality dependent on dietary fat levels ⁽⁶⁾ Use ROVIMIX® STAY-C®35 for reducing losses during processing ⁽⁷⁾ During winter feeding for wound healing and immune function: total 1000 mg/kg feed ⁽⁸⁾ For flesh pigmentation

OPTIMUM VITAMIN NUTRITION



HORSES & OTHERS

HORSES & OTHERS

Category/Phase	Weight	Vit. A	Vit. D ⁽³⁾	Vit. E	Vit. K ₃ (menadione)	Vit. B ₁	Vit. B ₂	Vit. B ₆	Vit. B ₁₂	Niacin	d-Panto- thenic acid	Folic acid	Biotin	Vit. C ⁽⁷⁾⁽⁸⁾	Choline	β-carotene
	kg	I.U.	I.U.	mg	mg	mg	mg	mg	mg	mg	mg	mg	mg	mg	mg	mg
 Foals, 1st year⁽¹⁾	250	25000-30000	5000-5500	250-550	6-12	25-30	15-20	15-20	0,15-0,3	25-50	25-40	6-24	2-3	275-550	300-600	
 Leisure horses⁽¹⁾	550	35000-45000	3500-4500	550-1100	6-12	40-66	30-44	25-35	0,15-0,35	55-85	45-65	6-24	15-20		600-1200	
 Race horses⁽¹⁾	550	65000-80000	6500-8500	1100-3300	6-12	70-110	50-75	40-55	0,15-0,55	110-220	50-88	6-24	15-20	1100-2200	1000-1200	
 Mares and Stallions⁽¹⁾	550	65000-80000	6500-8500	1100-2500	6-12	70-110	50-75	40-55	0,15-0,55	110-220	50-88	6-24	15-30	1100-2200	1000-1200	1000-1250 ⁽⁹⁾
 Rabbits⁽²⁾		8000-12000	800-1200	40-60	1-2	1-2	3-6	2-3	0,01-0,02	40-60	10-15	0,2-0,5	0,10-0,20 ⁽⁶⁾	150-250	600-800	10-20
 Mink & Foxes⁽²⁾		10000-15000	1500-2000	100-200 ⁽⁴⁾	1-2	20-50 ⁽⁵⁾	10-20	10-20	0,03-0,06	20-40	8-20	0,6-1,0	0,30-0,60	100-200		



⁽¹⁾ Added per animal per day ⁽²⁾ Added per kg air-dry feed ⁽³⁾ Local legal limits need to be observed ⁽⁴⁾ Dietary fat higher than 3%: additional 5 mg/kg feed for each 1% dietary fat ⁽⁵⁾ When feeding raw fish additional 50 mg/kg feed ⁽⁶⁾ For fur production rabbits: 0,6 mg/kg feed ⁽⁷⁾ Recommended in stress condition and to enhance reproductive performance in breeders ⁽⁸⁾ Use ROVIMIX® STAY-C®35 for reducing losses during processing ⁽⁹⁾ ROVIMIX® β-carotene should be fed prior to oestrus and through pregnancy and 10 weeks post partum or at any time when a diet low in beta carotene is provided

OPTIMUM VITAMIN NUTRITION



COMPANION ANIMALS

COMPANION ANIMALS

Category/Phase	Vit. A ⁽¹⁾	Vit. D ₃	Vit. E ⁽²⁾	Vit. K ₃ (menadiione) ⁽³⁾	Vit. B ₁	Vit. B ₂	Vit. B ₆	Vit. B ₁₂ ⁽⁴⁾	Niacin	d-Panto- thenic acid	Folic acid	Biotin ⁽⁵⁾	Vit. C ⁽⁶⁾	Choline	β-carotene ⁽⁷⁾
	I.U.	I.U.	mg	mg	mg	mg	mg	mg	mg	mg	mg	mg	mg	mg	mg
 Dogs	7100-23000	640-1100	50-500	1,7-2	3-8	7-60	2-60	0,04-0,10	20-170	17-150	0,3-2	0,3-10	100-200	2100-3000	30-150
 Cats	9000-25000	750-1300	50-550	1-2	7-10	5-27	4-14	0,03-0,10	60-170	8-60	1-2	0,1-0,80	100-200	3200-3300	30-50

“Expressed as unti/kg air-dry food with energy density of 4000 kcal ME/ kg of dry matter. The dietary vitamin concentration should be corrected for energy density if the food energy density is greater than 4000 kcal/kg.

⁽¹⁾ Vitamin A: preformed vitamin A is vital in diets for cats. ⁽²⁾ Vitamin E: supplemental levels should at least be 10 mg/kg of dry food for each 1% of PUFA in the diet. Higher levels are recommended to support the total antioxidant capacity of dogs and cats. ⁽³⁾ Vitamin K as Menadiione: supplementation is particularly important in canned cat foods that contains >25% fish when fed for long period of time. ⁽⁴⁾ Vitamin B12: higher levels of supplementation might be needed in vegetarian diets as plants are a poor source of this vitamin. ⁽⁵⁾ ROVIMIX® Biotin: Higher level is recommended for the improvement of coat and skin condition for cats and dogs. ⁽⁶⁾ Use ROVIMIX® STAY-C® 35 for reducing loss during processing and supporting the total antioxidant capacity of dogs and cats. ⁽⁷⁾ ROVIMIX® β-carotene: recommended for supporting the total antioxidant capacity of dogs and cats and as a modulator of immune function.

OVN®
OPTIMUM VITAMIN NUTRITION

OUR VISION ON VITAMIN NUTRITION

We believe that every single animal should receive the right level of vitamins. The reason is simple: vitamins are vital to their health, well-being and performance. Vitamins are the foundation for balanced animal nutrition.

Optimum Vitamin Nutrition (OVN™) is about feeding animals high quality vitamins in the right amounts and ratios appropriate to their life stage and growing conditions.

To accomplish this, we are intensely engaged in research and development and we focus on partnering with all important stakeholders – leading scientists, universities, genetics companies, independent research institutes,

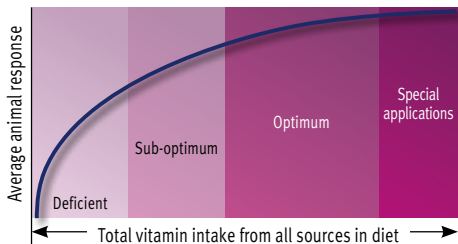
and customers. This enables us to develop and produce a complete line of high quality vitamins and support the feed industry with our Vitamin Supplementation Guidelines.

All ingredients in animal feed are regularly evaluated and likewise vitamin levels and ratios require the same degree of attention. We therefore encourage the feed industry and all other stakeholders to check the vitamin levels



in their animal feed. Always. With our extensive knowledge of vitamins and our worldwide network, we can help you to optimize your vitamin nutrition strategy.

OPTIMUM VITAMIN NUTRITION CONCEPT



Legend

'Total vitamin intake from all sources in the diet': total quantity of vitamins from natural sources plus supplementation.

'Average animal response': average productivity or health response of animal to vitamin intake e.g. growth rate, feed efficiency, reproductive performance, immunity.

'Deficient': a level of vitamin supplementation below NRC or other published recommendations which puts animals at risk of developing clinical deficiencies and disorders.

'Sub-optimum': vitamin supplementation, which meets or slightly exceeds NRC or other published recommendations, which should prevent, under good conditions, deficiency signs but inadequate for achieving optimum health and well-being, performance and nutritional value of animal-origin foods. Deficiency signs can occur in presence of stress and diseases.

'Optimum': cost-effective range of vitamin supplementation optimizing animal health and well-being, animal performance and the quality and nutritional value of animal-origin foods.

'Special applications': levels of vitamin supplementation which are safe and focused in improving certain attributes e.g. meat quality and immunity.

Factors influencing vitamin needs of domestic animals under commercial production conditions

Direct factors – stressors on animals: disease, confinement, restricted feeding, antagonists, anti-nutritional factors, air quality, temperature.

Indirect factors – variation of vitamin levels in feedstuffs: bioavailability, stability, quality of feedstuffs.

GUIDELINES FOR OPTIMUM VITAMIN NUTRITION

DSM Vitamin Supplementation Guidelines are designed to provide Optimum Vitamin Nutrition (OVN™) of domestic animals under typical industry practice.

OVN™ is a cost-effective range of vitamin supplementation optimizing animal health and well-being, animal performance and the quality and nutritional value of animal-origin foods. The supplementation levels required to attain Optimum Vitamin Nutrition generally exceed the levels needed to prevent signs of clinical deficiency.

OVN™ levels compensate for the many factors which can influence animals' requirements and corresponding feed levels, thus ensuring that vitamin fortification does not limit performance. OVN™ levels are ranges for consideration, depending on a range of factors, such as

husbandry conditions. They are based on extensive university and industry research, published requirements and practical experience.

All OVN™ levels are expressed in terms of vitamin activity to be added to diet. In general amounts given are per kg air-dry feed, except for ruminants and horses (per animal day).

The vitamin amounts stated are those which should be provided to the animal in the feed at the point of consumption. Additional vitamins should be added to the product to account for processing and shelf-life storage losses to achieve the targeted consumption amounts of vitamins.

These losses can be variable. Please ask your local DSM representative for information about typical levels of process and storage loss.

For some vitamins additional supplementation is indicated: these levels are safe and focused on improving certain attributes e.g. meat quality and immunity. The listed vitamin levels are only guidelines and, in all cases, national feed legislation must be followed.

CONVERSION FACTORS

Vitamin activity (active substance)	Conversion factor from active substance to vitamin form
1 IU Vitamin A (retinol)	0,344 µg Vitamin A acetate (retinyl acetate)
1 IU Vitamin D ₃ (cholecalciferol)	0,025 µg Vitamin D ₃
1 µg 25OHD ₃	40 IU Vitamin D ₃ (cholecalciferol)
1,0 mg Vitamin E (tocopherol)	1,0 mg DL- α-Tocopheryl acetate
1,0 mg Vitamin K ₃ (menadione)	2,0 mg Menadione Sodium Bisulfite (MSB) 2,3 mg Menadione Nicotinamide Bisulfite (MNB)
1,0 mg Vitamin B ₁ (thiamine)	1,088 mg Thiamine mononitrate 1,12 mg Thiamine hydrochloride
1,0 mg Vitamin B ₆ (pyridoxine)	1,215 mg Pyridoxine hydrochloride
1,0 mg d-Pantothenic acid	1,087 mg Calcium d-pantothenate 2,174 mg Calcium dl-pantothenate
1,0 mg Biotin	1 mg D-Biotin
1,0 mg Vitamin C	1 mg L-Ascorbic acid
1,0 mg Choline	1,15 mg Choline chloride



STANDARD DSM VITAMINS FOR ANIMAL NUTRITION

Vitamin	Product form	Content (min.)	Formulation technology	Application*
Vitamin A	ROVIMIX® A 1000	1.000.000 IU/g	Cross linked beadlet	M, P, EXP, EXT
	ROVIMIX® A 500 WS	500.000 IU/g	Spray-dried powder water dispersible	MR/W
	ROVIMIX® AD ₃ 1000/200	Vitamin A 1.000.000 IU/g Vitamin D ₃ 200.000 IU/g	Cross linked beadlet	M, P, EXP, EXT
β-carotene	ROVIMIX® β-carotene 10%	10% (100 g/kg)	Encapsulated beadlet	M, P, EXP, EXT
	ROVIMIX® β-carotene 10% P	10% (100 g/kg)	Cross linked beadlet	M, P, EXP, EXT
Vitamin D ₃	ROVIMIX® D ₃ -500	500.000 IU/g	Spray-dried powder, water dispersible	M, P, EXP, EXT, MR/ W
	ROVIMIX® AD ₃ 1000/200	Vitamin A 1.000.000 IU/g Vitamin D ₃ 200.000 IU/g	Cross linked beadlet	M, P, EXP, EXT
25OHD ₃	ROVIMIX® Hy-D® 1,25%	1,25% (12,5 g/kg)	Spray-dried powder, water dispersible	M, P, EXP, EXT, MR/ W
Vitamin E	ROVIMIX® E-50 Adsorbate	500 IU/g (50%)	Adsorbate on silicic acid	M, P, EXP, EXT
	ROVIMIX® E 50 SD	500 IU/g (50%)	Spray-dried powder, water dispersible	M, P, EXP, EXT, MR/ W

Vitamin K3	K3 MSB	Menadione: 51,5% (515 g/kg)	Fine crystalline powder	M, P, EXP, EXT, MR/ W
	ROVIMIX® K3 MNB	Menadione: 43% (430 g/kg) Nicotinamide: 30,5% (305 g/kg)	Fine crystalline powder	M, P, EXP, EXT, MR/ W
Vitamin B1 (thiamine)	ROVIMIX® B1	98% (980 g/kg)	Fine crystalline powder	M, P, EXP, EXT
	Thiamine Hydrochloride	98% - 101%	Fine crystalline powder	MR/W
Vitamin B2	ROVIMIX® B2 80-SD	80% (800 g/kg)	Spray-dried powder	M, P, EXP, EXT, MR/W
	Riboflavin 5'-Phosphate Sodium	75% - 79%	Fine crystalline powder	MR/W
Vitamin B6	ROVIMIX® B6	99% (990 g/kg)	Fine crystalline powder	M, P, EXP, EXT, MR/W
Vitamin B12	Vitamin B12 1% Feed Grade	1% (10.000 mg/kg)	Fine powder	M, P, EXP, EXT,
	Vitamin B12 crystalline	96% - 100,5%	Fine crystalline powder	MR/W
Niacin	ROVIMIX® Niacin	99,5%	Fine crystalline powder	M, P, EXP, EXT,
	ROVIMIX® Niacinamide	99,5%	Fine crystalline powder	M, P, EXP, EXT, MR/W
d-Pantothenic acid	ROVIMIX® Calpan	98% (980 g/kg) Calcium 8,2% - 8,6%	Spray-dried powder water dispersible	M, P, EXP, EXT, MR/W
Folic acid	ROVIMIX® Folic 80 SD	80% (800 g/kg)	Spray-dried powder water dispersible	M, P, EXP, EXT, MR/W
	Folic acid	97% - 102%	Crystalline powder	MR/W

Biotin	ROVIMIX® Biotin	2% (20 g/kg)	Spray-dried powder water dispersible	M, P, EXP, EXT, MR/W
	ROVIMIX® Biotin HP			
Vitamin C	ROVIMIX® STAY-C® 35	35% of total phosphorylated ascorbic acid activity (350 g/kg)	Spray-dried powder	M, P, EXP, EXT
	ROVIMIX® STAY-C® 50	50% of total phosphorylated sodium salt ascorbic acid (500 g/kg)	Spray-dried powder	M, P, EXP, EXT, MR/W
	ROVIMIX® C-EC	97,5% (975 g/kg)	Ethyl-cellulose coated powder	M, P, MR/W
	Ascorbic acid	99% - 100,5%	Crystalline powder	MR/W

* **M:** Mash; **P:** Pellet; **EXP.:** Expansion; **EXT.:** Extrusion; **MR/W:** Milk replacer/Water

For more information about further DSM products and product forms please ask your local DSM representative.

ABOUT DSM

With over 80 years' experience, DSM is the world's leading supplier of fat-soluble and water-soluble vitamins, carotenoids, long-chain polyunsaturated fatty acids, enzymes, eubiotics and nutraceuticals to the feed, food, pharmaceutical and personal care industries.

Nutritional ingredient production

Reliability through backward integration

DSM operates nine bulk manufacturing and formulation sites across Europe, the United States and China. These sites produce the majority of nutritional ingredients sold as straight products or in premixes and concentrates.

Quality is at the heart of all our operations, and we work to a global quality standard, backed by our unique backward integration concept which gives unrivalled control over our supply chain. DSM has a dedicated logistics network based on three main distribution centres in Venlo (NL), Belvidere (USA) and Singapore.

Premixes and blending

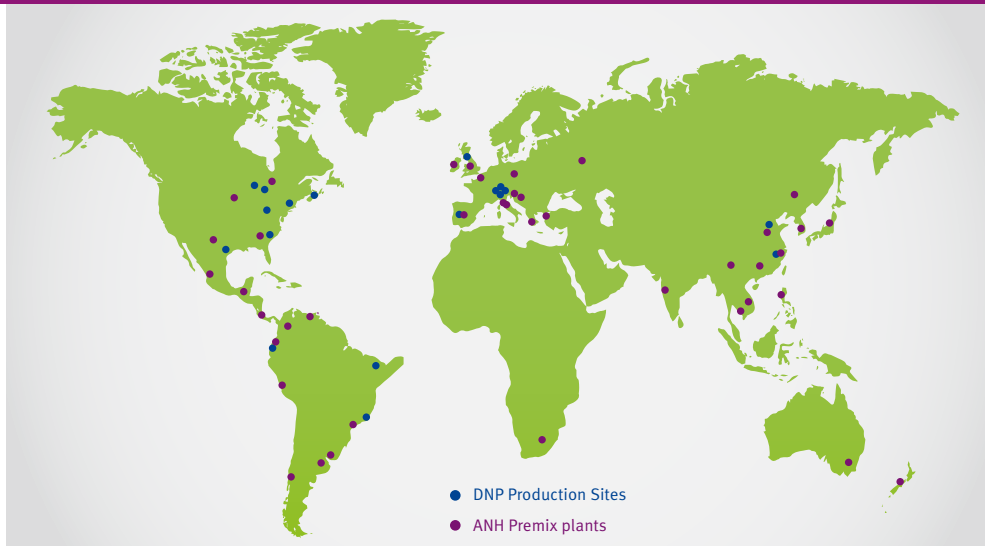
Product services where customers need them

DSM has a comprehensive global network of premix plants with over 40 plants dedicated to the production of feed premixes and 13 plants for human food premixes.

This network helps ensure high levels of customer service and delivery, backed by the highest levels of traceability, quality and food safety. Being close to our markets allows us to respond quickly to changing market demands.

NUTRITIONAL INGREDIENT PRODUCTION

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