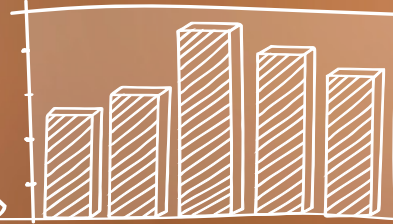


# OVN Optimum Vitamin Nutrition<sup>®</sup> Guidelines 2022



Check and adjust vitamin levels for more sustainable poultry farming.

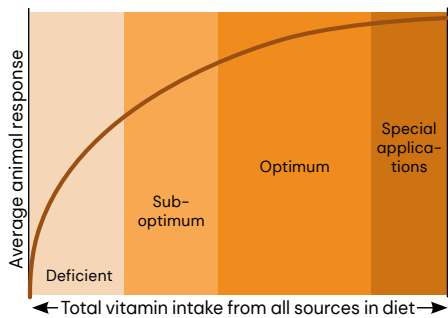


# Vitamins Contribute to More Sustainable Farming

Continuous advancements in poultry nutrition are essential to address opportunities and challenges of modern meat and egg production, including countering the rise of antibiotic resistance, reducing aggressive animal diseases and making farming more sustainable in alignment with the United Nations Sustainable Development Goals (SDGs). We at dsm-firmenich believe that supporting poultry species with appropriate vitamins can help make production more sustainable (SDG 12, 13) and help get the world closer to zero hunger (SDG 2) as well as healthy lives (SDG 3).

## Our Vision for Vitamin Nutrition

With these SDGs in mind, we believe that every single bird should receive the right level of vitamins. The reason is simple: vitamins are the foundation for balanced poultry nutrition.



OVN Optimum Vitamin Nutrition® is about feeding birds high quality vitamins, produced with the lowest environmental footprint, in the right amounts, appropriate to their life stage and growing conditions, to optimize:



### Protect your flock with confidence

#### • Animal Health and Welfare

Protect

► good for animals



### Perform efficiently with confidence

#### • Animal Performance

Perform

► good for producers



### Promote your product quality with confidence

#### • Food Quality & Food Waste

Promote

► good for consumers and the planet

To accomplish this, we are intensely engaged in research and development, and we focus on partnering with all important stakeholders – leading scientists, universities, genetic companies, independent research institutes and producers. 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 require the same degree of attention. We therefore encourage the poultry feed industry and all other stakeholders to **check** the vitamin levels in their poultry feed and **adjust** them accordingly **for more sustainable farming**.

## Guidelines for OVN Optimum Vitamin Nutrition®

dsm-firmenich Vitamin Supplementation Guidelines are designed to provide OVN Optimum Vitamin Nutrition® of animals under commercial industry practice.










OVN Optimum Vitamin Nutrition® is a cost-effective range of vitamin supplementation optimizing animal health and wellbeing, 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 Optimum Vitamin Nutrition® levels compensate for the many factors which can influence birds' requirements and corresponding feed levels, thus ensuring that vitamin fortification does not limit performance. OVN Optimum Vitamin Nutrition® levels are ranges for consideration, depending on several factors, such as health status and husbandry conditions. They are based on extensive university and industry research, published requirements and practical experience. All OVN Optimum Vitamin Nutrition® levels are expressed in terms of vitamin activity to be added per kg of feed.

The vitamin amounts stated are those which should be provided to the poultry 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-firmenich 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. egg and meat quality and immunity. The listed vitamin levels are only guidelines and, in all cases, national feed legislation must be followed.

# Main Functions of Vitamins and Symptoms of Deficiency in Poultry

Vitamin	Main functions	Deficiency symptoms
Vitamin A	<ul style="list-style-type: none"> <li>Essential for growth, health (immunity), reproduction (steroid synthesis), vision, development and integrity of skin, epithelia and mucosa</li> </ul>	<ul style="list-style-type: none"> <li>Blindness or night-blindness (xerophthalmia)</li> <li>Loss of appetite, poor absorption of nutrients, impaired growth and, in severe cases, death</li> <li>Decreased egg production and hatchability</li> <li>Reduced immune response and increased risk of infections (respiratory and intestinal)</li> <li>Keratinization of epithelial tissues</li> </ul>
Vitamin D <sub>3</sub>	<ul style="list-style-type: none"> <li>Homeostasis of calcium and phosphorus (intestine, bones and kidney)</li> <li>Regulation of bones calcification and eggshell formation</li> <li>Modulation of the immune system</li> <li>Muscular cell growth</li> </ul>	<ul style="list-style-type: none"> <li>Rickets, osteomalacia and bone disorders</li> <li>Lower eggshell quality (more cracked eggs)</li> <li>Reduced hatchability</li> <li>Reduced growth rate</li> <li>Muscular weakness</li> </ul>
25OHD <sub>3</sub>	<ul style="list-style-type: none"> <li>Major serum metabolite of vitamin D<sub>3</sub></li> <li>More efficient absorption in the intestine</li> <li>Faster response for calcium homeostasis</li> <li>More efficient modulation of the immune system and muscular cells than vitamin D<sub>3</sub></li> </ul>	<ul style="list-style-type: none"> <li>Rickets, osteomalacia and bone disorders</li> <li>Lower eggshell quality (more cracked eggs)</li> <li>Reduced hatchability</li> <li>Reduced growth rate</li> <li>Muscular weakness</li> </ul>
Vitamin E	<ul style="list-style-type: none"> <li>Most powerful fat-soluble antioxidant</li> <li>Immune system modulation</li> <li>Tissue protection</li> <li>Fertility</li> <li>Meat quality</li> </ul>	<ul style="list-style-type: none"> <li>Muscular dystrophy and myopathy</li> <li>Reduced immune response</li> <li>Encephalomalacia ("crazy chick disease")</li> <li>Reduced fertility and hatchability</li> <li>Meat quality defects: drip-loss, off-flavors</li> </ul>
Vitamin K <sub>3</sub>	<ul style="list-style-type: none"> <li>Blood clotting and coagulation</li> <li>Coenzyme in metabolic process related to bone mineralization (Ca binding proteins) and protein formation</li> </ul>	<ul style="list-style-type: none"> <li>Increased clotting time</li> <li>Hemorrhages</li> <li>Anemia</li> <li>Bone disorders</li> <li>Rough plumage</li> </ul>
Vitamin B <sub>1</sub>	<ul style="list-style-type: none"> <li>Coenzyme in several enzymatic reactions</li> <li>Carbohydrate metabolism (conversion of glucose into energy)</li> <li>Involved in ATP, DNA and RNA production</li> <li>Synthesis of acetylcholine, essential in transmission of nervous impulses</li> </ul>	<ul style="list-style-type: none"> <li>Loss of appetite up to anorexia</li> <li>Reduced growth rate</li> <li>Neuropathies (polyneuritis with neck twisting)</li> <li>General muscle weakness, poor leg coordination</li> <li>Embryo mortality</li> <li>Fatty degeneration and necrosis of heart fibers (cardiac failure)</li> <li>Mucosal inflammation</li> </ul>
Vitamin B <sub>2</sub>	<ul style="list-style-type: none"> <li>Fat and protein metabolism</li> <li>Flavin coenzyme (FMN and FAD) synthesis, essentials for energy production (respiratory chain)</li> <li>Involved in synthesis of steroids, red blood cells and glycogen</li> <li>Integrity of mucosal membranes and antioxidant system within cells</li> </ul>	<ul style="list-style-type: none"> <li>Reduced feed intake and growth</li> <li>Reduced absorption of zinc, iron and calcium</li> <li>Inflammation of the mucous membranes of the digestive tract</li> <li>Peripheral neuropathy, "curled toe paralysis", chickens walking on their hocks</li> <li>Reduced egg production</li> <li>Increased embryo mortality and reduced hatchability</li> </ul>
Vitamin B <sub>6</sub>	<ul style="list-style-type: none"> <li>Coenzyme in amino acid, fat and carbohydrate metabolism</li> <li>Essential for DNA and RNA synthesis</li> <li>Involved in the synthesis of niacin from tryptophan</li> </ul>	<ul style="list-style-type: none"> <li>Reduced growth rate, lesser feed intake and protein retention</li> <li>Dermatitis, rough and deficient plumage</li> <li>Inflamed edema of the eyelids</li> <li>Disorders of blood parameters, anemia and ascites</li> <li>Muscular convulsions followed by paralysis.</li> <li>Reduced hatchability</li> </ul>
Vitamin B <sub>12</sub>	<ul style="list-style-type: none"> <li>Synthesis of red blood cells and growth</li> <li>Involved in methionine metabolism</li> <li>Coenzyme in nucleic acids (DNA and RNA) and protein metabolism</li> <li>Metabolism of fats and carbohydrates</li> </ul>	<ul style="list-style-type: none"> <li>Anemia</li> <li>Reduced growth rate and lower feed conversion</li> <li>Defective feathering, poor plumage</li> <li>Leg weakness, perosis</li> <li>Gizzard erosion</li> <li>Reduced hatchability and higher embryo mortality</li> </ul>
Niacin or Vitamin B <sub>3</sub>	<ul style="list-style-type: none"> <li>Coenzyme (active forms NAD and NADP) in amino acid, fat and carbohydrate metabolism</li> <li>Required for optimum tissue integrity, particularly for the skin, the gastrointestinal tract and the nervous system</li> </ul>	<ul style="list-style-type: none"> <li>Nervous system disorders</li> <li>Inflammation and ulcers of mucous membranes</li> <li>Reduced growth and feed efficiency</li> <li>Lameness in young birds</li> <li>Reduced feathering</li> <li>Reduced egg production and hatchability</li> </ul>
Biotin or Vitamin B <sub>7</sub>	<ul style="list-style-type: none"> <li>Coenzyme in protein, fat and carbohydrate metabolism</li> <li>Normal blood glucose level</li> <li>Synthesis of fatty acids, nucleic acids (DNA and RNA) and proteins (keratin)</li> </ul>	<ul style="list-style-type: none"> <li>Fertility disorders</li> <li>Rough and brittle feathers, poor plumage</li> <li>Dermatitis of foot pads</li> <li>Deformation of the beak</li> <li>Fatty liver and kidney syndrome (FLKS)</li> </ul>
d-Pantothenic acid or Vitamin B <sub>5</sub>	<ul style="list-style-type: none"> <li>Present in Coenzyme A (CoA) and Acyl Carrier Protein (ACP) involved in carbohydrate, fat and protein metabolism</li> <li>Biosynthesis of long-chain fatty acids, phospholipids and steroid hormones</li> </ul>	<ul style="list-style-type: none"> <li>Functional disorders of nervous system</li> <li>Rough feathering and depigmentation</li> <li>Crusts at the corner of the beak, exudates on eyelids</li> <li>Fatty degeneration of the liver</li> <li>Reduced antibody formation</li> <li>Reduced growth and laying performance</li> <li>Reduced hatchability and increased embryo mortality</li> </ul>
Folic acid or Vitamin B <sub>9</sub>	<ul style="list-style-type: none"> <li>Coenzyme in the synthesis of nucleic acids (DNA and RNA) and proteins (methyl groups)</li> <li>Stimulates hematopoietic system</li> <li>With vitamin B12 it converts homocysteine into methionine</li> </ul>	<ul style="list-style-type: none"> <li>Megaloblastic (macrocytic) anemia</li> <li>Skin damages, rough plumage and feather depigmentation</li> <li>Cervical paralysis, leg weakness, perosis</li> <li>Reduced laying performance and hatchability</li> <li>Increased embryo mortality</li> </ul>
Vitamin C	<ul style="list-style-type: none"> <li>Intracellular (water-soluble) antioxidant</li> <li>Immune system modulation: stimulation of phagocytosis</li> <li>Egg shell membrane formation</li> <li>Formation of collagen, connective tissues, cartilage and bones</li> <li>Synthesis of corticosteroids and steroid metabolism</li> <li>Conversion of vitamin D<sub>3</sub> to its active form 1,25(OH)<sub>2</sub>D<sub>3</sub></li> </ul>	<ul style="list-style-type: none"> <li>Lower resistance to stress (e.g., low/high temperatures)</li> <li>Weakness and fatigue</li> <li>Reduced immune response</li> <li>Hemorrhages of the skin, muscles and adipose tissues</li> <li>Reproductive failures</li> </ul>
Choline	<ul style="list-style-type: none"> <li>Membrane structural component (phosphatidylcholine)</li> <li>Fat transport and metabolism in the liver</li> <li>Support nervous system function (acetylcholine)</li> <li>Source of methyl donors for methionine regeneration from homocysteine</li> </ul>	<ul style="list-style-type: none"> <li>Fatty liver</li> <li>Reduced growth rate</li> </ul>

Category/phase	Duration	Vitamin A	Vitamin D <sub>3</sub>	25OHD <sub>3</sub> (Hy-D <sup>3</sup> )	Vitamin E <sup>3,4</sup>	Vitamin K <sub>3</sub>	Vitamin B <sub>1</sub>	Vitamin B <sub>2</sub>	Vitamin B <sub>6</sub>	Vitamin B <sub>12</sub> <sup>7</sup>	Niacin	Biotin	d-Pantothenic acid	Folic acid	Vitamin C <sup>8</sup>	Choline	
Units		IU	IU	mg	mg	mg	mg	mg	mg	mg	mg	mg	mg	mg	mg	mg	
<b>BROILERS</b>																	
	<b>Broilers</b>																
	Starter	1 – 10 days	12,600 – 15,700	4,200 – 5,200	0.069	160 – 210 <sup>5</sup>	3.2 – 4.2	3.2 – 4.2	8.4 – 10.5	4.2 – 6.3	0.021 – 0.042	64 – 84	0.26 – 0.42	16 – 21	2.1 – 2.6	105 – 210	420 – 740
	Grower	11 – 24 days	10,500 – 13,100	4,200 – 5,200	0.069	55 – 105 <sup>5</sup>	3.2 – 4.2	2.1 – 3.2	7.4 – 9.5	4.2 – 6.3	0.021 – 0.032	64 – 84	0.26 – 0.42	12.6 – 19	2.1 – 2.6	105 – 210	420 – 740
	Finisher	25 days – market	10,500 – 13,100	4,200 – 5,200	0.069	55 – 105 <sup>5</sup>	3.2 – 4.2	2.1 – 3.2	6.3 – 8.4	4.2 – 6.3	0.021 – 0.032	53 – 84	0.26 – 0.42	10.5 – 15.8	2.1 – 2.6	105 – 210	420 – 630
	<b>Broiler breeders</b>																
	Starter/Grower (Pullets)	1 – 18 weeks	10,500 – 13,100	3,150 – 5,200	0.069	105 – 160 <sup>5</sup>	3.2 – 6	2.5 – 5	9 – 15	4.2 – 6.2	0.025 – 0.05	32 – 62	0.26 – 0.42	15 – 20	1.6 – 3	105 – 160	370 – 740
	Layers and male breeders	19 weeks – end	12,600 – 15,700	3,150 – 5,200	0.069 <sup>2</sup>	105 – 160	6 – 9	3.5 – 6	13 – 20	5 – 8	0.035 – 0.07	55 – 70	0.3 – 0.6	16 – 25	2.5 – 5	105 – 160	370 – 740
<b>TURKEYS</b>																	
	<b>Turkeys</b>																
	Starter	1 – 6 weeks	12,600 – 15,700	4,200 – 5,200	0.092	160 – 210 <sup>5</sup>	4.2 – 5.2	4.7 – 5.2	16 – 21	6.5 – 7.5	0.042 – 0.052	105 – 160	0.26 – 0.42	32 – 37	4.2 – 6.2	105 – 210	1,050 – 1,250
	Grower	7 – 12 weeks	10,500 – 12,600	3,200 – 5,200	0.092	65 – 85	3.2 – 4.2	3.2 – 5.2	11 – 16	5.5 – 7.5	0.032 – 0.042	85 – 105	0.26 – 0.32	21 – 26	2.1 – 3.1	105 – 210	525 – 1,050
	Finisher 1	13 – 18 weeks	8,400 – 10,500	3,200 – 4,200	0.092	32 – 52 <sup>6</sup>	3.2 – 4.2	3.2 – 4.2	8.5 – 10.5	3.2 – 6.2	0.022 – 0.032	65 – 85	0.21 – 0.26	16 – 21	2.1 – 2.6	105 – 210	420 – 630
	Finisher 2	19 weeks to market	6,300 – 9,400	3,200 – 4,200	0.092	32 – 52 <sup>6</sup>	3.2 – 4.2	2.2 – 3.2	8.5 – 10.5	3.2 – 6.2	0.016 – 0.026	52 – 63	0.21 – 0.26	16 – 21	2.1 – 2.6	105 – 210	420 – 630
	<b>Turkey breeders</b>																
	Starter	1 – 6 weeks	12,600 – 14,700	4,200 – 5,200	0.092	105 – 160 <sup>5</sup>	4.2 – 5.2	4.7 – 5.2	16 – 21	6.5 – 7.5	0.042 – 0.052	105 – 160	0.42 – 0.62	32 – 37	4.2 – 6.2	105 – 210	1,050 – 1,250
	Grower	7 – 29 weeks	8,400 – 10,500	4,200 – 5,200	0.092	65 – 85	2.2 – 4.2	2.2 – 3.2	11 – 16	6.5 – 7.5	0.032 – 0.042	65 – 85	0.42 – 0.62	26 – 31	2.2 – 3.2	105 – 210	1,050 – 1,250
	Layers and male breeders	Laying phase	12,600 – 14,700	4,200 – 5,200	0.092 <sup>2</sup>	105 – 160	4.2 – 5.2	4.2 – 5.2	16 – 21	6.5 – 7.5	0.042 – 0.052	85 – 125	0.42 – 0.62	32 – 37	4.2 – 6.2	105 – 210	525 – 1,050
<b>LAYERS AND OTHER POULTRY</b>																	
	<b>Hens and Duck layers</b>																
	Starter (pullets)	1 – 10 weeks	12,600 – 14,000	3,200 – 4,200	0.069	55 – 100 <sup>5</sup>	3.2 – 6	2.1 – 2.6	7 – 10	4.7 – 6	0.026 – 0.032	52 – 65	0.16 – 0.21	16 – 18	1.5 – 2	105 – 160	210 – 420
	Grower (pullets)	11 weeks – 2% lay	10,500 – 13,000	3,200 – 4,200	0.069	35 – 100	3.2 – 6	2.1 – 2.6	5.5 – 6.5	3.2 – 5.5	0.025 – 0.03	35 – 65	0.12 – 0.20	12.6 – 15.7	1.5 – 2	105 – 160	210 – 420
	Layers	Laying phase	8,500 – 13,000	3,200 – 4,200	0.069	25 – 50	3 – 6	2.6 – 3.2	5.5 – 7.5	4 – 5.5	0.02 – 0.03	35 – 55	0.12 – 0.20	8.5 – 12.5	1.5 – 2.5	105 – 210	320 – 520
	<b>Layer breeders</b>																
	Pullets, layers and male breeders	1 week to end	12,600 – 15,700	3,200 – 4,800	0.069 <sup>2</sup>	55 – 105 <sup>5</sup>	2.1 – 5.2	2.6 – 5	10.5 – 15	5.2 – 7	0.022 – 0.05	47 – 66	0.26 – 0.42	15.8 – 21	2.1 – 3.4	160 – 210	315 – 525
	<b>Ducks and Geese</b>	–	12,600 – 15,700	3,200 – 5,200	0.069	42 – 84	3.1 – 5.2	2.1 – 3.1	5.2 – 7.3	5.2 – 7.3	0.022 – 0.05	63 – 84	0.21 – 0.26	10.5 – 15.7	1.5 – 2.1	105 – 210	315 – 525
	<b>Partridges, quails and pheasants</b>	–	12,600 – 14,100	3,200 – 4,200	0.069	52 – 84	2.1 – 4.2	2.1 – 4.2	5.2 – 7.3	4.2 – 6.3	0.031 – 0.052	52 – 84	0.21 – 0.26	15.7 – 26.2	1.6 – 2.1	105 – 210	420 – 630
	<b>Ostrich and emu</b>	–	12,600 – 16,800	3,200 – 4,200	0.069	42 – 63	2.1 – 4.2	3.1 – 5.2	10.5 – 21	6.3 – 8.4	0.052 – 0.105	84 – 105	0.21 – 0.37	12.6 – 21.0	2.1 – 4.2	210 – 260	630 – 840

<sup>1</sup> Added per kg air-dried feed. Local limits need to be observed. OVN<sup>™</sup> levels are ranges for consideration, depending on several factors, such as husbandry conditions and health status.

<sup>2</sup> Add 60 mg/kg CAROPHYLL<sup>®</sup> Red to improve hatchability. MaxiChick<sup>™</sup> (Hy-D<sup>3</sup> 1,25% and CAROPHYLL<sup>®</sup> Red) is a dsm-firmenich Patent and Trademark.

<sup>3</sup> When dietary fat is higher than 3% then add 5 mg/kg feed for each 1% dietary fat

<sup>4</sup> Under heat stress conditions increase level up to 200 mg/kg

<sup>5</sup> For optimum immune function increase level up to 300 mg/kg

<sup>6</sup> For optimum meat quality increase level up to 200 mg/kg

<sup>7</sup> Use upper level as reference for animal protein free diets and when cobalt is supplemented at very low levels or removed

<sup>8</sup> Recommended under heat stress condition and to enhance reproductive performance in breeders. Use ROVIMIX<sup>®</sup> STAY-C35 for reducing loss during processing



## Conversion Factors and Standard dsm-firmenich Vitamins for Poultry

Vitamin (active substance)	Unit	Conversion factor active substance form to vitamin form	Product form	Content (min.)	Formulation technology	Application*
Vitamin A (retinol)	IU	1 IU Vitamin A = 0.344 µg Vitamin A acetate (retinyl acetate)	ROVIMIX® A 1000	1,000,000 IU/g	Beadlet	M, P, EXP, EXT
			ROVIMIX® A 500 WS	500,000 IU/g	Spray-dried powder, water dispersible	W
			ROVIMIX® A Palmitate 1.6	1,600,000 IU/g	Oily liquid, may crystallize on storage	Oily solution
			ROVIMIX® AD3 1000/200	Vitamin A 1,000,000 IU/g Vitamin D3 200,000 IU/g	Beadlet	M, P, EXP, EXT
Vitamin D <sub>3</sub> (cholecalciferol)	IU	1 IU Vitamin D <sub>3</sub> = 0.025 µg Vitamin D <sub>3</sub>	ROVIMIX® D3-500	500,000 IU/g	Spray-dried powder, water dispersible	M, P, EXP, EXT, W
			ROVIMIX® AD3 1000/200	Vitamin A 1,000,000 IU/g Vitamin D3 200,000 IU/g	Beadlet	M, P, EXP, EXT
25OHD <sub>3</sub> (25 hydroxy-cholecalciferol)	mg	1 µg 25OHD <sub>3</sub> = 40 IU Vitamin D <sub>3</sub>	ROVIMIX® Hy-D® 1.25 %	1.25% 25OHD <sub>3</sub> (12.5 g/kg)	Spray-dried powder, water dispersible	M, P, EXP, EXT, W
Vitamin E (tocopherol)	mg	1 mg Vitamin E = 1 IU Vitamin E = 1 mg all-rac-α-tocopheryl acetate	ROVIMIX® E-50 Adsorbate	50% (500 g/kg)	Adsorbate on silicic acid	M, P, EXP, EXT
			ROVIMIX® E 50 SD	50% (500 g/kg)	Spray-dried powder, water dispersible	M, P, EXP, EXT, W
Vitamin K <sub>3</sub> (menadione)	mg	1 mg of Vitamin K <sub>3</sub> = 2 mg of Menadione Sodium Bisulfite (MSB)	K3 MSB	Menadione: 51.5% (515 g/kg)	Fine crystalline powder	M, P, EXP, EXT, W
		1 mg of Vitamin K <sub>3</sub> = 2.3 mg of Menadione Nicotinamide Bisulfite (MNB)	ROVIMIX® K <sub>3</sub> MNB	Menadione: 43% (430 g/kg) Nicotinamide: 30.5% (305 g/kg)	Fine crystalline powder	M, P, EXP, EXT
Vitamin B <sub>1</sub> (thiamine)	mg	1 mg of Vitamin B <sub>1</sub> = 1.233 mg of Thiamine mononitrate	ROVIMIX® B <sub>1</sub>	98% (980 g/kg)	Fine crystalline powder	M, P, EXP, EXT
Vitamin B <sub>2</sub> (riboflavin)	mg		ROVIMIX® B <sub>2</sub> 80-SD	80% (800 g/kg)	Spray-dried powder	M, P, EXP, EXT, W
Vitamin B <sub>6</sub> (pyridoxine)	mg	1 mg Vitamin B <sub>6</sub> = 1.215 mg Pyridoxine hydrochloride	ROVIMIX® B <sub>6</sub>	99% (990 g/kg)	Fine crystalline powder	M, P, EXP, EXT, W
Vitamin B <sub>12</sub> (cyanocobalamin)	mg		Vitamin B <sub>12</sub> 1% Feed Grade	1% (10 g/kg)	Fine powder	M, P, EXP, EXT
			ROVIMIX® B <sub>12</sub> 1% Feed Grade	1% (10 g/kg)	Spray-dried powder	M, P, EXP, EXT
Vitamin B <sub>3</sub> (Niacin; nicotinic acid and nicotinamide)	mg	1 mg Nicotinic acid = 1 mg Niacin	ROVIMIX® Niacin	99.5% (995 g/kg)	Fine crystalline powder	M, P, EXP, EXT
		1 mg Nicotinamide (or Niacinamide) = 1 mg Niacin	ROVIMIX® Niacinamide	99.5% (995 g/kg)	Fine crystalline powder	M, P, EXP, EXT, W
Vitamin B <sub>7</sub> (d-Biotin)	mg	1 mg of Biotin = 1 mg D-Biotin	ROVIMIX® Biotin ROVIMIX® Biotin HP	2% (20 g/kg) 10% (100 g/kg)	Spray-dried powder, water dispersible	M, P, EXP, EXT, W
Vitamin B <sub>5</sub> (d-Pantothenic acid)	mg	1 mg d-Pantothenic acid = 1.087 mg Calcium d-pantothenate or 2.174 mg Calcium dl-pantothenate	ROVIMIX® Calpan	98% Calcium d-pantothenate (980 g/kg) Calcium 8.2 – 8.6% (82 – 86 g/kg)	Spray-dried powder, water dispersible	M, P, EXP, EXT, W
Vitamin B <sub>9</sub> (Folic acid)	mg		ROVIMIX® Folic 80 SD	80% (800 g/kg)	Spray-dried powder, water dispersible	M, P, EXP, EXT, W
Vitamin C	mg	1 mg Vitamin C = 1 mg L-Ascorbic acid	STAY-C® 35	35% of total phosphorylated ascorbic acid activity (350 g/kg)	Spray-dried powder	M, P, EXP, EXT
			STAY-C® 50	50% of total phosphorylated sodium salt ascorbic acid activity (500 g/kg)	Spray-dried powder	M, P, EXP, EXT, W
			ROVIMIX® C-EC	97.5% (975 g/kg)	Ethyl-cellulose coated powder	M, P, W
			Ascorbic acid	99 – 100% (990 – 1,000 g/kg)	Crystalline powder	W

\* M: Mash; P: Pellet; EXP: Expansion; EXT: Extrusion; W: Water

For more information about further dsm-firmenich products and product forms please ask your local dsm-firmenich representative

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