

OVN Optimum Vitamin Nutrition[®] Guidelines 2022



Check and adjust vitamin levels for more sustainable farming.

SWINE



ANIMAL NUTRITION AND HEALTH

ESSENTIAL
PRODUCTS

PERFORMANCE
SOLUTIONS +
BIOMIN[®]

PRECISION
SERVICES



DSM

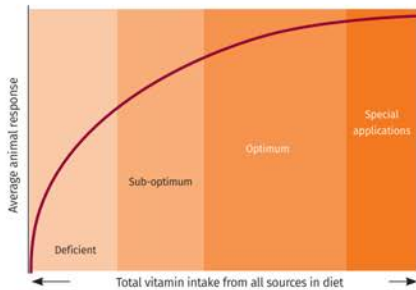
BRIGHT SCIENCE. BRIGHTER LIVING.

Vitamins Contribute to More Sustainable Farming

Continuous advancements in swine nutrition are essential to address opportunities and challenges of modern meat 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 believe that supporting nutrition 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 pig should receive the right level of vitamins. The reason is simple: vitamins are the foundation for balanced swine nutrition.



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

- **Animal Health and Welfare**
 - ▶ good for animals
- **Animal Performance**
 - ▶ good for farmers
- **Food Quality & Food Waste**
 - ▶ 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 swine feed industry and all other stakeholders to **check** the vitamin levels in their pig feed and **adjust** them accordingly **for more sustainable farming**.

Guidelines for OVN Optimum Vitamin Nutrition®

DSM 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 pigs' 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 pig 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. immunity, welfare and metabolic efficiency. 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 Swine

| Vitamin | Basic function(s) | Deficiency disorders/diseases |
|--|--|---|
| Vitamin A | <ul style="list-style-type: none"> Essential for growth, health (immunity), reproduction (steroid synthesis), vision, development and integrity of skin, epithelia and mucosa | <ul style="list-style-type: none"> Blindness or night-blindness (xerophthalmia) Loss of appetite, poor absorption of nutrients, decreased growth and, in severe cases, death Reduced immune response and increased risk of infections (respiratory and intestinal) Reproduction defects such as failure of spermatogenesis in the male and fetal resorption or death in the female swine. Dry and scaly skin Keratinization of epithelial tissues |
| Vitamin D ₃ | <ul style="list-style-type: none"> Homeostasis of calcium and phosphorus (intestine, bones and kidney) Regulation of bones calcification Modulation of the immune system Muscular cell growth | <ul style="list-style-type: none"> Rickets and osteomalacia Bone disorders (e.g., soft bones) and lameness Stiff and hesitant gait Reduced growth rate Muscular weakness |
| 25OHD ₃ | <ul style="list-style-type: none"> Major serum metabolite of vitamin D₃ More efficient absorption in the intestine Faster response for calcium homeostasis More efficient modulation of immune system and muscular cells than vitamin D₃ | <ul style="list-style-type: none"> Rickets and osteomalacia Bone disorders (e.g., soft bones) and lameness Stiff and hesitant gait Reduced growth rate Muscular weakness |
| Vitamin E | <ul style="list-style-type: none"> Most powerful fat-soluble antioxidant Immune system modulation Tissue protection Fertility Meat quality | <ul style="list-style-type: none"> Muscular dystrophy and myopathy Mulberry heart disease Reduced immune response Reduced fertility and Mastitis, Metritis and Agalactia (MMA) in sows Meat quality defects: drip-loss, off-flavours |
| Vitamin K ₃ | <ul style="list-style-type: none"> Blood clotting and coagulation Coenzyme in metabolic process related to bone mineralization (Ca binding proteins) and protein formation | <ul style="list-style-type: none"> Increased clotting time Haemorrhages diseases, anaemia and weakness Bone disorders Hematomas or blood swelling in the ears |
| Vitamin B ₁ | <ul style="list-style-type: none"> Coenzyme in several enzymatic reactions Carbohydrate metabolism (conversion of glucose into energy) Involved in ATP, DNA and RNA production Synthesis of acetylcholine, essential in transmission of nervous impulses | <ul style="list-style-type: none"> Loss of appetite up to anorexia and vomiting Reduced growth rate Neuropathies (polioencephalomalacia-PEM), general muscle weakness, poor leg coordination Fatty degeneration and necrosis of heart fibers (cardiac failure) Mucosal inflammation with gastrointestinal malfunction |
| Vitamin B ₂ | <ul style="list-style-type: none"> Fat and protein metabolism Flavin coenzyme (FMN and FAD) synthesis, essentials for energy production (respiratory chain) Involved in synthesis of steroids, red blood cells and glycogen Integrity of mucosa membranes and antioxidant system within cells | <ul style="list-style-type: none"> Reduced feed intake and growth Reduced absorption of zinc, iron and calcium Inflammation of the mucous membranes of digestive tract Scours and ulcerative colitis Fertility impairments |
| Vitamin B ₆ | <ul style="list-style-type: none"> Aminoacids, fats and carbohydrate metabolism Essential for DNA and RNA synthesis Involved in the synthesis of niacin from tryptophan | <ul style="list-style-type: none"> Growth retardation, lesser feed intake and protein retention Dermatitis, rough hair coat, scaly skin Disorders of blood parameters Brown exudate of the eyes Anaemia and ascites Muscular convulsions, incoordination of movements and paralysis |
| Vitamin B ₁₂ | <ul style="list-style-type: none"> Synthesis of red blood cells and growth Involved in methionine metabolism Coenzyme in nucleic acids (DNA and RNA) and protein metabolism Metabolism of fats and carbohydrates | <ul style="list-style-type: none"> Anaemia Growth retardation and lower feed conversion Leg weakness Embryo mortality, reduced piglet survival |
| Niacin or Vitamin B ₃ | <ul style="list-style-type: none"> Coenzyme (active forms NAD and NADP) in amino acids, fats and carbohydrates metabolism Required for optimum tissue integrity, particularly for the skin, the gastrointestinal tract and the nervous system | <ul style="list-style-type: none"> Nervous system disorders Inflammation and ulcers of mucous membranes Reduced growth and feed efficiency Dermatitis (pellagra), hair loss Ulcerative necrotic lesions of the large intestine, diarrhoea Reduced reproductive performance |
| Biotin or Vitamin B ₇ | <ul style="list-style-type: none"> Coenzyme in protein, fat and carbohydrates metabolism Normal blood glucose level Synthesis of fatty acids, nucleic acids (DNA and RNA) and proteins (keratin) | <ul style="list-style-type: none"> Reduced appetite, retarded growth Fertility disorders Skin ulcers, alopecia, hair loss and dermatitis Inflammation of the hooves and hoof-sole lesions Diarrhoea, eye inflammation and changes in oral mucosa |
| d-Pantothenic acid or Vitamin B ₅ | <ul style="list-style-type: none"> Present in Coenzyme A (CoA) and Acyl Carrier Protein (ACP) involved in carbohydrate, fat and protein metabolism Biosynthesis of long-chain fatty acids, phospholipids and steroid hormones | <ul style="list-style-type: none"> Functional disorders of nervous system Locomotive disorders Scaly skin, dermatitis Fatty degeneration of the liver Reduced antibody formation Reduced appetite, poor feed utilization and growth depression |
| Folic acid or Vitamin B ₉ | <ul style="list-style-type: none"> Coenzyme in the synthesis of nucleic acids (DNA and RNA) and proteins (methyl groups) Stimulates hematopoietic system With vitamin B₁₂ it converts homocysteine into methionine | <ul style="list-style-type: none"> Megaloblastic (macrocytic) anemia Skin damages and hair loss Retarded growth and reduced appetite Compromised reproduction in sows Embryonic mortality and smaller litter size |
| Vitamin C | <ul style="list-style-type: none"> Intracellular (water-soluble) antioxidant Immune system modulation: stimulation of phagocytosis Collagen biosynthesis Formation of connective tissues, cartilage and bones Synthesis of corticosteroids and steroid metabolism Conversion of vitamin D₃ to its active form 1,25(OH)₂D₃ | <ul style="list-style-type: none"> Weakness, fatigue and dyspnea Bone pain Haemorrhages of the skin, muscle and certain organs Reduced fertility in both males (reduced sperm quality) and females (termination of corpus luteum) |
| Choline | <ul style="list-style-type: none"> Membrane structural component (phosphatidylcholine) Fat transport and metabolism in the liver Support nervous system function (acetylcholine) Source of methyl donors for methionine regeneration from homocysteine | <ul style="list-style-type: none"> Fatty liver Growth retardation |
| β-carotene | <ul style="list-style-type: none"> Source of vitamin A Stimulation of progesterone synthesis Reproductive system function | <ul style="list-style-type: none"> Poor reproductive performance e.g., prolonged estrus, retarded follicle maturation and ovulation Increased susceptibility of young animals to infectious diseases |

SWINE¹

OVN Optimum Vitamin Nutrition[®]

| Category/phase | Duration | Vitamin A | Vitamin D ₃ | 25OHD ₃ (Hy-D) | Vitamin E ² | Vitamin K | Vitamin B ₁ | Vitamin B ₂ | Vitamin B ₃ | Vitamin B ₆ | Vitamin B ₁₂ ³ | Niacin | Biotin | d-Pantothenic acid | Folic acid | Vitamin C ⁴ | Choline | β-carotene | |
|--|-------------------|-----------------|------------------------|---------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|--------------------------------------|----------|--------------|--------------------|-------------|------------------------|-----------|------------------|--|
| UNITS | | IU | IU | mg | mg | mg | mg | mg | mg | mg | mg | mg | mg | mg | mg | mg | mg | mg | |
| Fattening pigs | | | | | | | | | | | | | | | | | | | |
|  | Pre-starter | < 5 kg | 10,500 – 22,500 | 1,890 – 2,100 | 0,05 | 105 – 160 ⁵ | 8.5 – 11 | 3.8 – 5.8 | 10.5 – 16 | 6.4 – 8.4 | 0.052 – 0.072 | 63 – 84 | 0.32 – 0.52 | 32 – 52 | 1.6 – 3.3 | 210 – 260 | 525 – 420 | - | |
| | Starter | 5 – 30 kg | 10,500 – 16,000 | 1,890 – 2,100 | 0,05 | 105 – 160 ⁵ | 5.2 – 6.4 | 3.2 – 5.2 | 10.5 – 16 | 6.4 – 8.4 | 0.042 – 0.062 | 38 – 58 | 0.32 – 0.52 | 26 – 46 | 1.6 – 2.6 | 105 – 210 | 260 – 420 | - | |
| | Grower | 30 – 70 kg | 7,350 – 10,500 | 1,570 – 2,100 | 0,05 | 64 – 105 ⁵ | 2.1 – 4.2 | 2.1 – 3.1 | 7.3 – 10.5 | 2.6 – 4.7 | 0.032 – 0.052 | 21 – 50 | 0.2 – 0.4 | 26 – 47 | 1.1 – 1.16 | - | 157 – 315 | - | |
| | Finisher | 70 kg to market | 5,250 – 8,400 | 1,050 – 1,570 | 0,05 | 64 – 105 ⁵ | 2.1 – 4.2 | 1.1 – 2.1 | 6.3 – 10.5 | 2.1 – 3.7 | 0.032 – 0.052 | 21 – 42 | 0.105 – 0.21 | 26 – 47 | 0.52 – 1.05 | - | 105 – 210 | - | |
| Breeders | | | | | | | | | | | | | | | | | | | |
|  | Replacement gilts | - | 10,500 – 13,100 | 1,900 – 2,100 | 0,05 | 84 – 105 | 2.5 – 4.4 | 1.05 – 2.2 | 6.3 – 10.5 | 5.3 – 8.4 | 0.032 – 0.052 | 30 – 50 | 0.32 – 0.52 | 16 – 33 | 3.7 – 5.7 | 210 – 315 | 270 – 525 | - | |
| | Sows | Gestation | 10,500 – 15,700 | 1,570 – 2,100 | 0,05 | 105 – 160 ⁵ | 4.7 – 5.2 | 2.1 – 2.6 | 6.3 – 10.5 | 3.7 – 5.7 | 0.032 – 0.052 | 32 – 47 | 0.52 – 0.84 | 37 – 42 | 3.7 – 5.7 | 210 – 315 | 525 – 840 | - | |
| | | Lactation | 10,500 – 15,700 | 1,570 – 2,100 | 0,05 | 105 – 190 ⁵ | 4.7 – 5.2 | 2.1 – 3 | 6.3 – 10.5 | 3.7 – 5.7 | 0.032 – 0.052 | 40 – 100 | 0.52 – 0.84 | 37 – 42 | 3.7 – 5.7 | 210 – 315 | 525 – 840 | 300 ⁶ | |
| | Boars | - | 10,500 – 15,700 | 1,570 – 2,100 | 0,05 | 105 – 160 | 4.7 – 5.2 | 1.05 – 2.2 | 6.3 – 10.5 | 3.7 – 5.7 | 0.032 – 0.052 | 32 – 47 | 0.52 – 0.84 | 21 – 33 | 3.7 – 5.7 | 210 – 525 | 525 – 840 | - | |

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

² When dietary fat is higher than 3% then add 5 mg/kg feed for each 1% dietary fat

³ For optimum immune function increase level up to 250 mg/kg

⁴ For optimum meat quality increase level up to 250 mg/kg for 90 to 120 days before slaughter

⁵ For optimum piglet health increase level up to 250 mg/kg during late pregnancy and lactation

⁶ Use upper level as reference for animal protein free diets and when cobalt is supplemented at very low levels or removed

⁷ Recommended under heat stress condition and to enhance reproductive performance in breeders. Use ROVIMIX[®] STAY-C35 for reducing loss during feed processing

⁸ For improved sow fertility the suggested level must be fed **per animal per day** immediately after weaning until confirmed conception



Conversion Factors and Standard DSM Vitamins for Swine

| 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/MR |
| | | | ROVIMIX® AD3 1000/200 | Vitamin A 1,000,000 IU/g Vitamin D ₃ 200,000 IU/g | Beadlet | M, P, EXP, EXT |
| Vitamin D ₃ (cholecalciferol) | IU | 1 IU Vitamin D ₃ = 0.025 µg Vitamin D ₃ | ROVIMIX® D ₃ -500 | 500,000 IU/g | Spray-dried powder, water dispersible | M, P, EXP, EXT, W/MR |
| | | | ROVIMIX® AD3 1000/200 | Vitamin A 1,000,000 IU/g Vitamin D ₃ 200,000 IU/g | Beadlet | M, P, EXP, EXT |
| 25OHD ₃ (25 hydroxy-cholecalciferol) | mg | 1 µg 25OHD ₃ = 40 IU Vitamin D ₃ | ROVIMIX® Hy-D 1.25% | 1.25% 25OHD ₃ (12.5 g/kg) | Spray-dried powder, water dispersible | M, P, EXP, EXT, W/MR |
| 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/MR |
| Vitamin K ₃ (menadiione) | mg | 1 mg of Vitamin K ₃ = 2 mg of Menadiione Sodium Bisulfite (MSB) | K ₃ MSB | Menadiione: 51.5% (515 g/kg) | Fine crystalline powder | M, P, EXP, EXT, W/MR |
| | | 1 mg of Vitamin K ₃ = 2.3 mg of Menadiione Nicotinamide Bisulfite (MNB) | ROVIMIX® K ₃ MNB | Menadiione: 43% (430 g/kg) Nicotinamide: 30.5% (305 g/kg) | Fine crystalline powder | M, P, EXP, EXT |
| Vitamin B ₁ (thiamine) | mg | 1 mg of Vitamin B ₁ = 1.088 mg of Thiamine mononitrate | ROVIMIX® B ₁ | 98% (980 g/kg) | Fine crystalline powder | M, P, EXP, EXT |
| Vitamin B ₂ (riboflavin) | mg | | ROVIMIX® B2 80-SD | 80% (800 g/kg) | Spray-dried powder | M, P, EXP, EXT, W/MR |
| | | | Riboflavin 5'-Phosphate Sodium | 75 – 79% (750 – 790 g/kg) | Fine crystalline powder | W/MR |
| Vitamin B ₆ (pyridoxine) | mg | 1 mg Vitamin B ₆ = 1.215 mg Pyridoxine hydrochloride | ROVIMIX® B ₆ | 99% (990 g/kg) | Fine crystalline powder | M, P, EXP, EXT, W/MR |
| Vitamin B ₁₂ (cyanocobalamin) | mg | | Vitamin B ₁₂ 1% Feed Grade | 1% (10 g/kg) | Fine powder | M, P, EXP, EXT |
| | | | Vitamin B ₁₂ crystalline | 96 – 100% (960 – 1000 g/kg) | Fine crystalline powder | W/MR |
| Vitamin B ₃ (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/MR |
| Vitamin B ₇ (d-Biotin) | mg | 1 mg of Biotin = 1 mg D-Biotin | ROVIMIX® Biotin ROVIMIX® Biotin HP | 2% (20 g/kg) | Spray-dried powder, water dispersible | M, P, EXP, EXT, W/MR |
| Vitamin B ₅ (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/MR |
| Vitamin B ₉ (Folic acid) | mg | | ROVIMIX® Folic 80 SD | 80% (800 g/kg) | Spray-dried powder, water dispersible | M, P, EXP, EXT, W/MR |
| Vitamin C | mg | 1 mg Vitamin C = 1 mg L-Ascorbic acid | ROVIMIX® 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/MR |
| | | | ROVIMIX® C-EC | 97.5% (975 g/kg) | Ethyl-cellulose coated powder | M, P, W/MR |
| | | | Ascorbic acid | 99 – 100% (990 – 1000 g/kg) | Crystalline powder | W/MR |
| β-Carotene | mg | | 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 |

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

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



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For more information, contact your representative today.



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