Essentials for infants and young children

Health benefit solutions
Human milk represents the nutritional gold standard for infant nutrition and we strongly support the WHO recommendation that infants should be exclusively breastfed for the first six months of life to achieve optimal growth, development and long-term health. Thereafter, older infants and young children should receive nutritionally adequate and safe complementary foods, while continuing to breastfeed for up to two years or more. We believe that breastfeeding is an unequalled way of providing ideal food for the healthy growth and development of infants and is also an integral part of the reproductive process with important implications for the health of mothers.

For many reasons, however, not every infant will be fed breast milk exclusively for 6 months. Indeed, some mothers choose not to breastfeed; some mothers may breastfeed only part of the time and a small percentage perhaps cannot breastfeed their babies. Infant formula, although it can never equal breast milk, is formulated in an attempt to ensure that the most nutritionally complete substitute possible is made available for babies who are not breastfed. Breast milk should be the nutritional gold standard by which formula milk should be assessed. The industry’s goal over the years has been to continually improve the quality and safety of infant formula. We believe that components like DHA and ARA, as well as other infant nutrition innovations, help achieve this goal.

Building a Foundation for Optimal Growth and Development

Mounting research through the past few decades continues to highlight the role nutrition plays during infancy and its effect on factors relevant to health later in life including cardiovascular health, allergies, bone health, and the development of obesity. The first 1,000 days between the onset of a woman’s pregnancy and her child’s second birthday offer a unique window of opportunity for nutrition to shape healthier futures. It is essential that infants (0-12 months) and young children (1-3 years) receive the necessary nutrients at appropriate levels to help set them on a path to a long, healthy life. Breast milk continues to be the nutritional gold standard for infant feeding, but in situations where breast milk is not available to the infant, parents rely on formulas and fortified foods designed to deliver the nutrients needed for optimal growth and development. These key nutrients promote healthy growth and development by supporting brain and eye development, maintaining a healthy immune system, and ensuring normal skeletal development.

Empower their Minds
The human brain begins forming very early in prenatal life. Gestation through the first years of life marks the most rapid period of brain growth and development. The brain continues to grow and develop — although at a slower rate, throughout early childhood. During this critical time, the brain is producing billions of cells and forming connecting pathways between different regions of the brain. These pathways are essential for the successful development of cognitive, motor, and sensory skills. Optimal nutrition plays a very important role in ensuring the structural maturation of the brain and proper functioning of the nervous system. Inadequate brain growth can result in behavioral and cognitive deficits, lower IQ, and poor school performance, all of which can have life-long consequences. To facilitate healthy brain growth, infants must be provided with a key blend of nutrients including: long chain-polyunsaturated fatty acids (LC-PUFAS) such as omega-3 docosahexaenoic acid (DHA) and omega-6 arachidonic acid (ARA), carotenoids, amino acids, vitamins and minerals to support this time of critical development.

Support their Vision
At birth, two of the main anatomical structures of the eye (retina and fovea) are poorly developed, thus newborns can only discern vague shapes at a high contrast to their surroundings. Infancy and early childhood are periods of rapid eye development with visual acuity improving to near adult levels by four years of age. Healthy eyes and vision play a fundamental role in how infants and young children learn as well as perceive the world around them. A proper balance of nutrients is essential for optimal eye development. Shortages of key nutrients can result in vision problems and developmental delays. Nutrients that support eye health in infants and young children include DHA, lutein, zeaxanthin and vitamins A and E.

Protect their Health
The immune system begins to develop in the womb and continues to mature during the first two years of life. Many of the key antibodies (disease fighting proteins) transferred to the fetus during pregnancy disappear within the first three months of life, leaving infants with immature immune systems. Breast milk provides immunological support from mother to infant, providing infants with a blend of key nutrients such as DHA, ARA, nucleotides, vitamins, and minerals. As weaning foods are introduced in the infant diet, the demand for key nutrients to support immunity remains high. Traditionally, parents begin by introducing fortified baby cereals into their infant’s diet, which contains all the essential proteins, fibers, vitamins and minerals needed to support a healthy immune system. Nutrition is not only a key source of antigens, which are foreign substances that the immune system needs to recognize and tolerate, but also provides factors which might support immune maturation and response.

Build Strong Bones
Skeletal growth and development during infancy sets the stage for bone health throughout life. Bones are living, dynamic tissues that are continually being remodeled. The body maintains a delicate balance between the process of bone formation and resorption. To support infants’ rapidly growing bodies, it is fundamental to ensure they receive optimal levels of vitamins and minerals to maximize their peak bone mass. Peak bone mass determines the resistance and susceptibility to bone fracture. Proper nutrition results in higher peak bone mass during infancy, which lays the groundwork for maintaining bone health throughout life. Key nutrients for bone health include minerals such as calcium, phosphorus, magnesium, zinc, and vitamins B6, C, D, and K.
Docosahexaenoic acid (DHA) and arachidonic acid (ARA) are long chain omega-3 and omega-6 polyunsaturated fatty acids (LC-PUFAS) that are found in all cells of the body. DHA is the most abundant omega-3 fatty acid in the brain and the retina of the eye, representing about 97% and 93% of all the omega-3 fatty acids found in the brain and eyes, respectively. ARA is the primary omega-6 fatty acid in the brain, representing about 48% of the omega-6 fats found there.3,4,13,14 To indicate their importance in nutrition, DHA and ARA often are referred to as “conditionally essential nutrients” for the development and function of infant cognition and vision. These fatty acids also contribute to an infant’s cardiovascular and immune function. The metabolism and functional activity of these two fatty acids are interconnected and their health benefits are best characterized when considered together.

Maternal intake of DHA during pregnancy influences the DHA status of the developing fetus and infant. DHA supplementation studies conducted during pregnancy identify important health benefits for the infant, but also the young child. Cognitive,15–21 vision,20,21,23 and immune function24–26 benefits are reported in the offspring of mothers who had a higher DHA intake and/or status during pregnancy. DHA and ARA are natural components of breast milk27 and studies have consistently shown infant blood DHA and ARA levels decrease significantly following birth, unless the infant receives a source either from breast milk or, if not possible, a supplemented infant formula.28–35 Breast feeding is the optimal method for infant feeding, and breast milk always contains both DHA and ARA. Infant formula supplemented with DHA and ARA provides an alternative source of these fatty acids for those infants whose mothers are unable to or elect not to breast feed.

For nearly 20 years, there has been a research focus on the role of DHA and ARA in infant health and development. On the basis of this clinical evidence, recommendations have been made by several expert groups to assure the adequate intake of DHA and ARA during infancy.36–42 Breast feeding studies also highlight the importance of DHA during early life, and mothers can increase the levels of DHA in their breast milk through supplementation. Maternal DHA supplementation during lactation results in mental development advantages in children43–46 including improved psychomotor development (such as eye-hand coordination) at 2.5 years of age45 and improved attention skills at 5 years of age.46

Infants fed DHA and ARA-supplemented formula exhibited better visual acuity than that of the non-supplemented infants, and the supplemented infants’ visual acuity was similar to that of breast-fed infants.58–62
Empower their Minds

The physiological demand for DHA and ARA begins early in life. The brain grows rapidly during the last months of gestation and throughout the first years of life.2,4-6,8 Infants born prematurely do not have time to accumulate DHA to the same level as their full-term counterparts. When fed formula supplemented with DHA and ARA, preterm infants achieved normal growth in terms of weight, length, and head circumference,4-6,8 and demonstrated improved visual and mental development compared to infants fed formula without DHA and ARA.5

Many studies demonstrate improved mental development in term infants fed DHA and ARA supplemented formula compared to those receiving unsupplemented formula. These benefits extend well beyond the period of supplementation and continue into childhood.5,6 For example, infants fed DHA and ARA supplemented formula scored 7 points higher on the Bayley Mental Development Index at 18 months than those fed unsupplemented formula.13 This test measures a child’s level of cognitive, motor, and behavioral development. In a follow-up study of those same children at age 4, visual acuity and verbal IQ scores were higher in those children who had received supplemented formula compared with those who received formula lacking DHA and ARA.15 Furthermore, omega-3 supplementation during weaning also demonstrates positive effects on brain development. Infants supplemented with omega-3 from 9-12 months of age, exhibited positive effects on scores of attention.14 Additional research conducted and measured using the same methods has shown a positive link between scores of attention and stronger vocabulary in childhood.5,7

Support their Vision

DHA is the most abundant omega-3 fatty acid in the retina of the eye, and is important for healthy visual development.2-4 Infants who were breast-fed and then weaned to formula supplemented with DHA and ARA demonstrated more mature visual acuity (clearness of vision) than those breast-fed infants weaned to non-supplemented formula.5-7 Infants fed DHA and ARA-supplemented formula exhibited better visual acuity than that of the non-supplemented infants, and the supplemented infants’ visual acuity was similar to that of breast-fed infants.60-63

Protect their Health

In addition to the key role DHA and ARA play in brain and eye development and function, recent studies have shown LC-PUFAs may help modulate immune responses. DHA and ARA are used by the body to make molecules that regulate inflammation and the immune response including resistance to infection and tolerance to allergens.63 One study showed that infants fed formula supplemented with DHA and ARA had fewer episodes of bronchiolitis and bronchitis at ages 5, 7, and 9 months compared to infants fed non-supplemented formula.44 Infants fed formula supplemented with DHA and ARA during infancy had reduced incidence of upper respiratory infections and common allergic diseases at age 3.65 Another study examining the relationship between DHA and respiratory health in children concluded that increases in DHA intake in toddlers might improve immune function and development, including respiratory health.66

Guard their Heart

Infants fed formula supplemented with DHA and ARA had significantly lower blood pressure compared to infants fed non-supplemented formula, similar to that of breast-fed infants. Because blood pressure tends to track from childhood into adult life, it has been suggested that early intake of DHA and ARA may reduce the risk of cardiovascular disease later in life.49 A recent study of 12-year-old children reported those receiving higher levels of omega-3 LC-PUFA in breast milk exhibited improved blood pressure parameters at 12 years of age, compared to those who did not.49 This benefit was unrelated to their current omega-3 LC-PUFA status.
Lutein and zeaxanthin may be important not only for visual and cognitive health in adult life, but also for the healthy development of the eyes and brain during gestation and early infancy. Recent research suggests that these two powerful antioxidants may influence maturation and/or play protective roles during critical periods of fetal and neonatal development. During gestation and lactation the infant is dependent on its mother’s nutritional status to get adequate levels of lutein and zeaxanthin. Infants who are breast-fed obtain these critical nutrients through colostrum and breast milk, while formula-fed infants can only get lutein and zeaxanthin from a supplemented infant formula. Colostrum, the first of the mother’s breast milk, is uniquely adapted to fulfill the needs of the newborn by supplying critical immune components, including protein and a high amount of lutein. Lutein is highly concentrated in colostrum. Over the course of a few weeks, the lutein content of breast milk gradually decreases by about half. This suggests that Nature has found a way to concentrate lutein in colostrum to deliver an initial “bolus” dose that protects the newborn infant. Most infant formulas do not contain lutein and zeaxanthin, which may explain why breast-fed infants typically have significantly higher blood plasma levels of lutein and zeaxanthin than formula-fed infants.

Lutein and zeaxanthin are concentrated in the infant brain. It is known that the “eyes are windows to the brain” and that the macula of the retina is the sensitive neurological tissue that transmits information to the visual cortex. Lutein and zeaxanthin are highly concentrated within the infant brain in the hippocampus, occipital lobe, frontal cortex and auditory lobe — areas involved in sight, memory and learning. Similar to other carotenoids, lutein and zeaxanthin are effective antioxidants, protecting cells against damage induced by free radicals. Lutein and zeaxanthin are the only carotenoids present in this tissue. The retina is highly vulnerable to damage by ultraviolet light in infancy, which is one reason why newborn infants need antioxidant protection. The presence of lutein in breast milk may represent a means of providing this protection. Newborn infants are vulnerable to oxidative stress because of their high metabolism and low levels of antioxidant enzymes. A study in healthy newborns found that infants supplemented with lutein had better antioxidant protection and lower levels of markers of oxidative stress. Furthermore, lutein supports retinal health in preterm infants. A new study in premature infants shows that supplementation of breast milk with lutein enhances rod photoreceptor sensitivity, an indicator of retinal health.
Nucleotides are vital components of all living cells. They play major roles in almost all physiological processes, particularly in cells that replicate and proliferate rapidly, such as in developing and repairing tissues. They are building blocks of DNA and RNA and have an important function in cellular energy and metabolism.

Protect their Health
Periods of rapid growth, during pregnancy and in infancy, increase the demand for nucleotides in tissues with fast turnover, such as the digestive and immune systems.82 Research has shown that nucleotides are present in breast milk as they are required for the production of new cells in the rapidly growing infant.83–85 It appears that supplementation of infant formula with nucleotides results in better growth and increased resistance to infections by enhancing responses to vaccines, while promoting the growth of "good" bacteria which protect the gut against harmful bacteria and thus reduce the incidence of diarrhea.86 Infants fed formula supplemented with nucleotides show similar immune responses to breast-fed infants.87

Oat Beta-Glucan
Dietary fiber plays an important role in the body as it helps to maintain gut health, regulate bowel movements and increase fecal bulk.88,89 Dietary fibers can be found in fruits, vegetables, whole-grain products, nuts, seeds, beans and other legumes. Oat bran is an excellent source of both insoluble and soluble fibers and is used to contribute to the daily recommended dietary fiber intake. The beneficial properties of oat are attributed to the soluble fibers that occur naturally in the grain, which are called beta-glucan.

Protect their Health
Oat beta-glucan may promote gut health via improvement in digestion in young children, as they may become agitated from constipation or gas. Oat beta-glucan may help to alleviate constipation through improvement of bowel function by increasing fecal bulk89. Currently, oat beta-glucan can be used to fortify cereals for young children (ages 1-3 years old) in the European Union, but regulatory approval may vary on a global basis.
Vitamins and Minerals

Vitamins and minerals are essential for good health in every stage of the human lifecycle. They are essential for normal metabolism, growth and physical well-being, including supporting disease prevention. Vitamin deficiency disorders may occur when dietary intake does not meet metabolic demands. Infants need optimal vitamin and mineral status to promote postnatal growth and reduce infant morbidity and mortality. Each of the 13 vitamins known today have specific functions in the body, which makes every one of them unique and irreplaceable. Vitamins are essential for life!

Empower their Minds

All nutrients are important for brain development, but some appear to have greater effects on the developing brain. The B-complex vitamins (B1, B2, B6, B12, Biotin and Folic Acid) are relevant to brain structure and neurological function because they are needed for the synthesis of several neurotransmitters.

The minerals iron, zinc and copper play instrumental roles in infant brain development. The growing infant brain has a high demand for iron, as it is an essential nutrient for rapidly proliferating and/or differentiating tissues in the brain. Iron also helps to transport oxygen to the brain. An iron deficiency in early life may result in learning and memory deficits. Zinc is found in high concentrations in the brain. It is critical for structural aspects of brain development and may also play a role in behavioral and cognitive aspects of brain function.

Upgrade their Vision

Vitamins A and E are essential for healthy eyesight. Vitamin A is needed for black and white differentiation, which may help vision at night. Vitamin E’s antioxidant function protects the eyes from high levels of oxidation, which can result in cell damage, thus compromising cell function and altering maturation.

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Protect their Health

Antioxidants such as vitamin A, C and E and carotenoids have an immune boosting impact as they can both protect and repair cells affected by free radicals. Free radicals have the potential to damage DNA, proteins, carbohydrates, lipids and cell membranes. The balance of free radical production and the level of antioxidant defenses have important disease and health implications. If there are too many free radicals produced and too few antioxidants to combat them, a condition of oxidative stress develops and can lead to chronic injury.

Many research articles highlight the potential role of select vitamins and trace elements in supporting immune function; it is prudent, therefore, to ensure adequate intake of vitamins and trace elements. Low vitamin C status is associated with a reduction in the bacterial killing efficiency of white blood cells. Studies have shown that vitamin C may help to decrease the duration and/or severity of the common cold. Vitamin E is the principal fat soluble antioxidant in cell membranes, and it supports improved immune function by helping to prevent the spread of free radical reactions.

Build Strong Bones

The blueprint for strong bones begins early in life and essential nutrients play a vital role in guiding bone development over the years. Calcium and zinc are the essential minerals for bone development and formation. Furthermore, calcium intake is positively associated with increases in bone mass and bone structure in children. Magnesium, zinc, fluorine, and phosphorus are necessary for building healthy bones as they are components of the bone matrix. Vitamin D plays a critical role in maintaining the mineral balance in the body and is required for the absorption of calcium and phosphate to facilitate bone mineralization and healthy bone formation. Studies have shown that vitamin D supplementation in infants and young children is associated with higher bone mineral mass in adolescence. However, vitamin D does not work alone in supporting healthy bone formation. Vitamin K activates a protein that binds calcium into the structure of the bone, and vitamins C and B6 are necessary for collagen synthesis, an essential part of the organic material that binds bones together.

Vitamin D is a critical micronutrient for strengthening the immune system by facilitating regulation and differentiation of immune cells. The American Academy of Pediatrics (AAP) has doubled its recommended dose of vitamin D for infants and children because of growing evidence to support the role of vitamin D in maintaining general immunity and preventing disease. Vitamin D may help protect the respiratory tract from infections and has emerged as a potential risk modifier for autoimmune diseases including Type 1 Diabetes.
Nutritional solutions for infants and young children

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Function for Infants and Toddlers</th>
<th>Recommended Daily intakes1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vitamins2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quali-PA (Vitamin A)</td>
<td>Vision; skin, mucous membranes; bones; red blood cells; immune function</td>
<td>0–6 mths: 400 µg. 6–12 mts: 500 µg</td>
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<tr>
<td>Quali-IB (Vitamins B1, B2, B3, B5, B6, B12, folic acid)</td>
<td>Involved in protein, carbohydrate and fat metabolism; nucleic acid metabolism</td>
<td>0–3 At recommended dietary allowance</td>
</tr>
<tr>
<td>Quali-IC (Vitamin C)</td>
<td>Immune function; collagen formation; iron absorption; antioxidant, phagocyte function</td>
<td>0–6 mts: 40 mg. 6–12 mts: 50 mg</td>
</tr>
<tr>
<td>Quali-ID (Vitamin D)</td>
<td>Calcium and phosphorus absorption and metabolism; cardiovascular health; blood pressure; bone health; muscle strength; immune function; dental health</td>
<td>0–6 mts: 10 µg. 6–12 mts: 10 µg</td>
</tr>
<tr>
<td>Quali-II (Vitamin E)</td>
<td>Red blood cells and tissues; antioxidant</td>
<td>0–6 mts: 3 mg. 6–12 mts: 5 mg</td>
</tr>
<tr>
<td>Quali-IR (Vitamin K)</td>
<td>Blood clotting: bone health</td>
<td>0–6 mts: 2.0 µg. 6–12 mts: 2.5 µg</td>
</tr>
<tr>
<td>Biotin (Vitamin H)</td>
<td>Involved in protein, carbohydrate and fat metabolism as well as many other cellular reactions</td>
<td>0–6 mts: 5 µg. 6–12 mts: 6 µg</td>
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<tr>
<td>Carnitines</td>
<td></td>
<td></td>
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<tr>
<td>FloraGLO® (Lutein)</td>
<td>Concentrated in the macula; filters high-energy light</td>
<td>0–12 mts: 250 µg/l</td>
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<tr>
<td>Nutritional Lipids4,5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>life’sDHA® (DHASCO®)</td>
<td>Brain and eye development and function; heart health; immune function, growth and development</td>
<td>0–6 mts: 32-112 mg.</td>
</tr>
<tr>
<td>life’sARA™ (Omega-6 LC PUFA, ABRSCO®)</td>
<td>Brain and eye development and function; immune function, growth and development</td>
<td>0–6 mts: 12-187 mg. 6–12 mts: 153 mg.</td>
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<tr>
<td>Nutraceuticals</td>
<td></td>
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<tr>
<td>OatWell™ (Oat beta glucan)</td>
<td>May promote gut health via improvement in digestion, can be used to contribute to the daily recommended dietary fiber intake</td>
<td>1–3 years: Dietary fiber: 10 g/day</td>
</tr>
<tr>
<td>Minerals and Trace Elements</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calcium</td>
<td>Bones; teeth; blood clotting; muscle contractions; heart beat; nerve function; blood pressure</td>
<td>0–6 mts: 200 mg. 6–12 mts: 260 mg</td>
</tr>
<tr>
<td>Copper</td>
<td>Red blood cells; bone formation. Deficiency depresses the adaptive immune response</td>
<td>0–6 mts: 200 µg. 6–12 mts: 220 µg</td>
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<tr>
<td>Iron</td>
<td>Cofactor in immune-related enzymes; red blood cells</td>
<td>0–6 mts: 0.27 mg. 6–12 mts: 11 mg. 1–3 years: 7 mg.</td>
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<tr>
<td>Magnesium</td>
<td>Muscle relaxation; nerve function; heart rhythm</td>
<td>0–6 mts: 30 mg. 6–12 mts: 35 mg.</td>
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<tr>
<td>Phosphorus</td>
<td>Bone formation; cell formation and growth; energy reactions</td>
<td>0–6 mts: 100 mg. 6–12 mts: 275 mg</td>
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<tr>
<td>Selenium</td>
<td>Antioxidant enzymes. Deficiency depresses antibody production</td>
<td>0–6 mts: 15 µg. 6–12 mts: 20 µg. 1–3 years: 20 µg</td>
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<tr>
<td>Zinc</td>
<td>Protein metabolism. Deficiency depresses production of lymphocytes</td>
<td>0–6 mts: 2 mg. 6–12 mts: 3 mg</td>
</tr>
<tr>
<td>Nucleotides6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Added Nucleotides</td>
<td>May promote healthy growth and development of the immune system</td>
<td>0–12 mts: 5 mg</td>
</tr>
<tr>
<td>Cytidine-5′-Monophosphate Free Acid</td>
<td>May promote healthy growth and development of the immune system</td>
<td>0–12 mts: 1.75 mg</td>
</tr>
<tr>
<td>Uridine-5′-Monophosphate Disodium</td>
<td>May promote healthy growth and development of the immune system</td>
<td>0–12 mts: 1.5 mg</td>
</tr>
<tr>
<td>Inosine-5′-Monophosphate Disodium</td>
<td>May promote healthy growth and development of the immune system</td>
<td>0–12 mts: 1.0 mg</td>
</tr>
<tr>
<td>Guanosine-5′-Monophosphate Disodium</td>
<td>May promote healthy growth and development of the immune system</td>
<td>0–12 mts: 0.5 mg</td>
</tr>
<tr>
<td>Adenosine-5′-Monophosphate Free Acid</td>
<td>May promote healthy growth and development of the immune system</td>
<td>0–12 mts: 1.5 mg</td>
</tr>
</tbody>
</table>

How can we Health you?

The first 1,000 days between the onset of a woman’s pregnancy and her child’s second birthday offer a unique window of opportunity for nutrition to shape healthier futures. It is essential that infants and young children receive the necessary nutrients at appropriate levels to help set them on a path to a long, healthy life. DSM’s tailored nutrients can support infants and young children to grow to their full potential.

DSM’s broad portfolio of innovative, high-quality and safe nutrients, combined with our consumer insights, market knowledge and application expertise, can help you create products with appealing health solutions.

We are the only integrated premix, vitamin and nutraceutical manufacturer capable of creating and delivering tailor-made formulations to you anywhere. Blend in our extensive scientific expertise, technical know-how, global presence and total quality assurance for your peace-of-mind.

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DSM can help you develop appealing health solutions.
DSM Nutritional Products

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