NUTRI-FACTS
Understanding Vitamins & More

Latest scientific news and established facts about micronutrients as quickly accessible information in multiple languages.

Background information on study results and expert comments.

Results of national and international nutrition surveys and market research reports.

Transparency in the complex relationship between micronutrients and health.

An initiative of DSM
2 MenaQ7 Crystals® Ingredient innovation rationale
Vladimir Badmaev

6 Company Profile
G & G Vitamins

8 Vital help with vitamins
Marta Ajihado

11 Tailored yeast based health solutions to fit specific market needs
Morgane Maillard

14 BCM-95® curcumin and staying fit
Terry Lemerond
NattoPharma of Oslo, Norway, has initiated a project to create MenaQ7® brand of vitamin K2 that can significantly impact the international market for vitamin K2 – and specifically its derivative menaquinone-7 – in direct response to the growing importance placed by the medical community of this vitamin supplementation for bone and cardiovascular health. The market for natural vitamin K2 is already significant, approaching five tons in the US, and 1.5 tons in EU – and with this it has not even begun to realize its potential. Asia, with the exception of India, has only begun promoting vitamin K2 for health purposes, and the smaller but developing markets in South America, such as Brazil, have yet to begin. However, growing epidemiological evidence indicates that a burgeoning percent of the global population, which otherwise appears healthy, is deficient in vitamin K2; this has far-reaching consequences for overall health, well-being and economies of many countries.

For these reasons, we evaluated the commercial landscape and K2 offerings and found them lacking. First and foremost, NattoPharma has set out to produce the highest quality and consistency menaquinone-7, a challenge that has plagued many K2 manufacturing processes. Many of the existing products have allergens and contaminants such as soy and antifoaming agents as well as impurities carried over from the fermentation process. The new MenaQ7 fermentation-process starting materials and excipients are soy free and hypoallergenic. In addition, MenaQ7 complies with EU substantial equivalence and US GRAS Compositions including stability, safety, preclinical and clinical research data.

What is probably the most significant technological breakthrough in the new generation of MenaQ7 is a proprietary multistep process of purification, condensation and crystallization of fermentation-derived K2. This innovative process leads to an end product that is more than 95% pure natural menaquinone-7 or MK-7, with less than 0.5% (traces) of menaquinone-6 (MK-6), a marker of natural menaquinone-7 technology (note: MK-6 is not present in a synthetic MK-7 product). The all-natural MenaQ7 crystals are also free of other menaquinones, e.g. MK-3, MK-4, MK-5, MK-8 etc. which is important for a higher rate of gastrointestinal absorption, bioavailability to target tissues, e.g. bone and blood vessels, and may also contribute to safety of K2.

There are three more uniquely significant factors that define the new MenaQ7 crystals.

1. The pure MenaQ7 Crystals can be used directly in food, food supplements, premixes and multivitamins without the customary excipients – resulting in much desired space and weight savings in finished vitamin K2-containing products. In other words, it is more economical, manufacturing-wise and financially because you use less to obtain desired amounts.

2. MenaQ7 Crystals are 100% defined for their composition and impurities in their Drug Master File (DMF) documentation which allows use of MenaQ7 crystals in pharma compositions.
3. MenaQ7 Crystals can be reconstituted in oil, e.g. medium-chain triglycerides of safflower oil, sunflower oil and coconut oil or mixed with appropriate carriers for obtaining triturated powder form.

NEW MENAQ7 CRYSTALS: MANUFACTURING PROCESS

The new MenaQ7 Crystals are manufactured according to current good manufacturing practices (cGMPs). The strain used in the production of the new MenaQ7 brand of menaquinone-7 is *Bacillus licheniformis*, a non-toxicogenic and non-pathogenic strain. The strain has been well characterized by employing gross morphological characters, biochemical reactions and by 16S RNA.

The menaquinone-7 is prepared by submerged fermentation using *B. licheniformis* as the producing strain and chickpea flour (chickpea flour is flour made from dried chickpeas or garbanzo beans, and is also known as gram flour) and dextrin as carbon and nitrogen sources. The chickpea is used in the manufacture instead of soy beans to minimize potential for allergens from legumes. The menaquinone in the fermentation broth is spray dried and extracted with hexane with no detectable residual solvent. The menaquinone-7 is extracted in vegetable oil and subject to process of purification, concentration and crystallization to obtain the MenaQ7 Crystals.

The purification process leads to crystals that are the pure physical form of vitamin K2 (Figure 1). The final commercial product is used in the form of crystals diluted either in MCT oil or in a powder mixture containing non-animal, vegetable ingredients.

Ten attractive features and benefits of new MenaQ7 Crystals

1. **Crystals stand for consistency**: Well defined no less than (NLT) 95% purity menaquinone-7, consistent yield from fermentation, with virtually no other constituents of the fermentation process which may interfere with absorption and bioavailability of menaquinone-7.

2. **Crystals epidemiology and safety**: Nature produces only one kind menaquinone-7, the *trans* form, which is the only safe and effective form of this vitamin. The pure *trans* menaquinone-7 is assured in crystals. No need for excipients eliminates potential allergens and unsafe additives.

3. **Crystallization space saving in food and food supplements**: The real estate is at a premium in multivitamin tablets and premix blends, with high purity material, e.g. crystals of vitamin C, B12 and B6 in high demand by manufacturers to provide for a smaller size of the tablet.

4. **Incorporation in pharma products**: Crystals wouldn’t have the hurdles of incorporation in pharma products. Such combination products need the drug master file (DMF).

5. **Crystals analytical**: The strict regulatory norms can be easier fulfilled working with high purity crystals with purity and impurities profile defined 100% in the drug master file (DMF).

6. **Transport, warehousing and handling**: The high purity translates to compact size and negligible weight for transportation and handling.

7. **EFSA, GRAS, Kosher, Halal, etc**: All certifications and safety studies are valid for the menaquinone-7 crystals, creating numerous market opportunities.

8. **Efficacy**: Peer-review published preclinical and clinical studies on MenaQ7®.


10. **HACCP**: The HACCP-certified manufacture facility gives added advantage to MenaQ7 Crystals.

The resulting products of advanced MenaQ7 Crystals are characterized by:

- No less than 95% content of only *trans* MK-7 with less than 0.5% MK-6;
- No other detectable menaquinones;
- Solvent under the detectable levels;
- Improved stability profile in storage and in finished supplement and food preparations;
- The product is protected by granted patents for use as dietary supplements and functional food, for all cardiovascular health claims in US, EU and Canada.

Based on these characteristics it is implicit that MenaQ7 Crystal will have an
improved gastrointestinal absorption rate, higher rate of activating target proteins, e.g. osteocalcin and MGP and an increased bioavailability of K2-dependent proteins activating target receptors in the body.

The manufacturing process employed in the production of MenaQ7 Crystals ensures that the potential for contamination or introduction of impurities is low, and each batch manufactured is tested to ensure that the stringent purity criteria are met. Processing aids, such as solvent (removed by vacuum evaporation) and buffer salts used in the manufacturing process are all food-grade quality and comply with specifications described in the 5th Edition of Food Chemicals Codex.

NEW MENAQ7 CRYSTALS: REGULATORY STATUS

In the US the new MenaQ7 crystal form is considered a dietary supplement, since menaquinone-7 containing products in the United States are regulated under the Dietary Supplement Health and Education Act (DSHEA, 1994). In addition, New MenaQ7 meets the specifications as self-affirmed GRAS to be used as a nutrient [21 CFR §170.3(o) (20)] at maximum use levels of up to 10 μg/serving in specific foods (Fats & Oils; Milk Products; Cheese; Frozen Dairy; Confectionary & Frosting; Beverages Type I – Non-alcoholic; Seasonings & Flavors, Soups) resulting in the 90th percentile all-user estimated intake of 36.51 μg menaquinone-7/person/day.

The new effort is to utilize MenaQ7 in so-called medicinal food. The medicinal food is distinguished from regular food by the higher dose of menaquinone-7 allowable per serving based on the three-year clinical study of MenaQ7 among healthy postmenopausal women in preserving bone mass and strength and the cardiovascular health.

In EU MenaQ7 Crystals meet the specifications outlined recently by the European Commission for European Food Safety Authority (EFSA). In 2008, in response to a request to deliver a scientific opinion on the safety of "vitamin K2" as a source of vitamin K for nutritional purposes to foodstuffs, EFSA examined the safety of vitamin K2. After considering all the data on specifications, manufacturing, anticipated intake, bioavailability, metabolism and toxicity, the EFSA Panel concluded that the use of menaquinone-rich (primarily menaquinone-7) edible oil in foods for the general population (including food supplements) and in foods for particular nutritional uses, other than baby foods and infant formula, at the use levels of 10 μg/serving is not of safety concern.

In Japan the menaquinone-7 rich natto is considered under The Food for Specified Health Use (FOSHU) regulations, i.e. incorporation of natto in the daily diet could help bone health. The New MenaQ7 may comply with FOSHU regulations in Japan, and most likely with TGA regulations in Australia. The efforts to establish MenaQ7 in various countries in view of tight regulatory environment is supported because of the long-term clinical studies conducted on a healthy population.

NEW MENAQ7 CRYSTALS: EFFECTIVE BIOLOGICAL MECHANISM

Menaquinone-7 is a co-substrate for the enzyme gamma-glutamyl carboxylase in the post-translational synthesis of gamma-carboxyglutamic acid (Gla) from glutamic acid (Glu) residues in the nascent Gla-protein molecules, e.g. osteocalcin, playing a critical role in bone and metabolic health. Vitamin K2 is also an effective cofactor for production of blood coagulation proteins and active matrix Gla-protein (MGP) for elasticity and prevention of calcification of blood vessels. Other functions of vitamin K2 include suppression of the inflammation, and prevention of free-radical pathology.

It was not until the three-year breakthrough study of MenaQ7 completed in May 2012 that there has been a clinical study showing that supplemental vitamin K, especially menaquinone-7, improves bone mineral density, bone strength and cardiovascular health and metabolic health (Vermeer C. et al., 2012 VitaFoods Presentation). The

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Table I – General description of MenaQ7® Crystals active component.

Five distinguishing characteristics of MenaQ7® Crystals
1. A minimum 95% purity standardized for menaquinone-7, 100% trans form, no other forms of menaquinone present except for 0.5% or less admixture of menaquinone-6 – a marker of natural fermentation product.
2. Screened out other menaquinones except for minute amount of MK-6, which provides better bioavailability of MK-7 and better safety profile.
3. A proprietary non-soy based fermentation product unique to NattoPharma.
5. Supported by clinical research and patents granted and pending.
breakthrough study was a double-blind randomized clinical trial evaluating the results of a three-year regular intake of MenaQ7 in a daily dose of 180 μg by a group of 244 healthy post-menopausal Dutch women, 55 to 65 years old, randomly assigned to receive daily either MenaQ7 or identical looking placebo capsules. This brand new three-year study of MenaQ7 is a “breakthrough” study because it shows for the first time clinically statistically significant protection of the vertebrae and the hip (femoral neck) against osteoporosis and cardiovascular deterioration. One of the most important findings from the study was that clinically relevant improvement became evident no sooner than after two and three years of MenaQ7 supplementation. This finding explains for the first time why shorter studies e.g. 12 months, typically failed to show benefits of vitamin K on bone health and cardiovascular health. Establishing a correlation between length of administration and efficacy of menaquinone-7 intake is a clinically significant breakthrough established in this three-year study of MenaQ7. The MenaQ7 trial additionally showed for the first time substantial benefits in preventing age-related stiffening of arteries resulting in statistically significant increase of the pulse wave velocity (PWV) in the placebo group, but not in the MenaQ7-group. Previously the positive effects on bone and vascular health have been demonstrated only with a pharmacological dose of the synthetic form of vitamin K, of up to 45 mg per day. The MenaQ7 study shows for the first time in the history of vitamin K evaluation the positive health effects with a “nutritional” dose of vitamin K (180 μg/day for three years), e.g., a dose that can be obtained from a healthy Western-type diet. The dose of 180 μg is higher than current recommended daily dose of vitamin K of approximately 90 μg. This higher dose resulting in clinical benefits and no side effects in the course of the three year study may attest to safety of MenaQ7 and open discussion for new guidelines for supplemental dose of vitamin K2.

The discussion of an effective dose of vitamin K2 is particularly relevant in view of recent epidemiological studies suggesting that most adults, apparently healthy, may be sub-clinically K2 deficient – which results in 10-40% of K2-dependent proteins not carboxylated and biologically inactive. In addition, the emerging understanding of vitamin K2 biological mechanism indicates that carboxylation of proteins may only be a step in activation of K2 dependent proteins. The bioavailability of activated protein to the target receptor, e.g. in osteoblasts/osteoclasts or endothelial cells may depend on multiple steps in activation of K2 dependent protein. The current generation of MenaQ7 in the form of crystals may provide an effective method in activating K2-dependent proteins.

NattoPharma’s distinguished New MenaQ7 Crystals are now ready for marketing partners to formulate their own innovative health products for a consistently growing marketplace that desires effective, top-quality tools to manage their healthy lifestyles.
G&G Vitamins
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United Kingdom
+44 (0)1342 311 401

G&G Brand of Vitamins, Minerals and Live Cultures:

G&G Vitamins have long since serviced the European health trade providing the G&G brand of high quality, high strength products to trade and distributor outlets in Holland, Germany, Austria, Hungary, Czech Republic, Slovakia, Spain and Ireland to name a few. In fact we supply our products to 51 different countries throughout the world. We find that our European market will not compromise with quality – and neither will we. We attribute the G&G Brand’s success in Europe to this attitude.

Contract Manufacturing:

G&G began in 1965, providing high strength vitamin E and one of the first vitamin and mineral formulas to the consumer. With a reputation for high quality, practitioners soon demanded the G&G products as well as the research information G&G provided to health practitioners.

Instead of buying from third parties, G&G decided that the best way to ensure their products met their own high standards was to begin manufacturing their own brand. As reputation spread, this service became more and more in demand. So in 1987, G&G began to contract manufacture ‘own label’ products for other companies – with great success. From beginning in the home of David and Sheila Gaiman to now occupying a 31,000 sq ft building G&G grew both in reputation and size.

G&G are the largest independent manufacturer of supplements based in the UK; we supply ‘own label’ services to many of the biggest, award winning brands in the UK, and Europe.

The Manufacturing Process:

G&G uses an exceptionally pure method to encapsulate its supplements, known as TRUFIL®. First we obtain the purest form of the ingredients necessary for your formulation. All the ingredients are carefully weighed
to maintain the correct ratios and then blended together. Where the powder quantity per capsules is very small (i.e. too small to fill a significant amount of the capsule) then steam-treated rice flour is used to bulk up the capsule as this in no way affects your formulation. Once blended and mixed the powder is sieved before being encapsulated.

The encapsulation process works with three sizes of capsules (4, 0 or 00) and either vegetarian or gelatine capsules. Empty capsule shells are inserted into a ring which is then split in two. The blended ingredients are then inserted into one of the ring before the two halves are combined using hydraulics. We offer short runs of 30,000 capsules fully packaged or in bulk, as well as powders.

**Quality Control:**

At G&G we have an entire division devoted solely to monitoring and maintaining quality; in fact, Quality Control is involved in every aspect of our manufacturing process. After arrival from suppliers, raw materials are quarantined until checked by Quality Control. Once the formula worksheet has been issued the raw materials are collected from the warehouse and brought into the clean room. Raw material batches are recorded on the worksheet for every ingredient that goes into your product. As well as this a weighting scale printout documents correctly weighed out quantities which is verified against the worksheet then signed off and attached to the worksheet. All containers are marked with traceable batch numbers and product identification. This ensures that only the exact quantities specified on your formula are used. A form is attached to the formula worksheet detailing the exact steps to be taken at each part of the process to ensure no detail is missed or overlooked. Quality Control checks every part of the manufacturing process; from weight and colour to the machine and its operators. Once the process is complete Quality Assurance performs weight checks as well as spot checks for any errors inside the tub or bottle. This ensures that quality is never compromised. Metal detection checks are done on every capsule as a matter of course.

**Clean Room:**

Our vitamins and minerals are produced in an ISO Class 9 Pharmaceutical clean room, which means the air and temperature levels are automatically controlled with 20 complete air changes every hour. The entire production process from unpacking raw materials to bottling the capsules happens inside our clean room to maintain product quality and lack of contamination. Our state of the art polishing, packing, labelling and shrink-wrap machines take care of the rest.

**G&G’s Certification:**

G&G’ manufacturing processes have Organic certification from The Soil Association. Rabbi Adler has certified our production processes and facilities to meet kosher standards as well as 73 of G&G’s own label products receiving kosher accreditation.

G&G has been inspected and has achieved the AIB internationally recognized GMP standard. G&G has been an affiliated company of the Chartered Quality Institute since 1996. G&G is a member of the Health Food Manufacturers Association (HFMA). Every staff member at G&G is given an individual training programme depending on their function, to ensure they are an expert in their field.

Contact us today for your free quotation
bparker@gandgvitamins.com
For any manufacturer looking to incorporate vitamins, and any other functional ingredients, in their products the key issue of stability must be addressed as soon as possible during the product development process. The point is that many factors will affect whether ingredients such as vitamins can survive in the product up to its proposed ‘use by’ date. Hence a knowledge of their stability, or instability, can influence many aspects of the product such as the design of packaging, storage conditions, labelling claims, and of course, the product formulation.

With pharmaceutical products, stability studies are a fundamental part of the drug development process. Indeed, specific studies are required to support progress through to the various phases of clinical trials well before a drug can ever be brought to market. For food products and health food supplements, the regulatory obligation might appear to be a little less strict. However, the essential point remains that if the product label claims that a certain ingredient/active is present at a specific concentration, then it must be present, not only when the product leaves the factory but up to the ‘use by’ date published on the label. The only way to substantiate such a claim is to test the product at the end of its proposed shelf life, but testing also during the product development stage can do much to clear the way for launch of the finished product.

ACCELERATED TESTING

There is a mistaken belief that there is a magic formula for accelerated testing (i.e. where the product is stored at extremes of temperature and humidity) that can avoid the need to test a product over the entire course of its proposed shelf life. Unfortunately, the results of accelerated testing still need a baseline of test results at normal storage conditions against which to be compared. Accelerated testing is only useful for assessing whether the chosen storage conditions are worthy of further consideration. It is not a quick way to bypass the proper longer term stability testing that is needed.

Of course, ‘normal’ means different things for different products. An item that is intended to be stored in a sealed container in a frozen condition is clearly different from one packaged in glass that is stored in ambient conditions and exposed to daylight. Hence the laboratory providing stability testing must be equipped with a variety of storage facilities to mimic actual conditions of use. These will include all rooms, chambers, ovens, fridges and freezers that can provide controlled environments of temperature, humidity and light appropriate to the specific product being challenged.

Similarly, the range of analytical expertise on offer must also be extensive. The measurement of vitamin D in margarine will involve different extraction and analytical procedures compared with the analysis, say, of green tea in a baked product, or of glucosamine in a cereal bar. Even the simplest food is a complex mixture of different chemicals, which may have the potential to interfere with test results, so the methods used must be properly evaluated and validated.

VITAMINS AND OTHER INGREDIENTS

An increasing number of products are now being fortified with vitamins, either derived from natural sources or via synthetic routes. From an analytical perspective, it makes little difference, though once again, any claims that the vitamin is derived from a ‘natural’ source must be substantiated by the manufacturer.

The potential for adding vitamins, and other functional ingredients to a product, is to some extent dictated by their water solubility or fatty characteristics.

Water Soluble Vitamins

The vitamins most easily added to soft drinks, and other water-based products, are the water soluble B vitamins. Vitamin B1 (thiamine) is frequently added as thiamine hydrochloride, which is more soluble in water than the other commercially available form, thiamine mononitrate. It is relatively stable in low pH solutions and therefore suitable for most fortified fruit drinks. Niacin (vitamin B3) is also very stable. Vitamin B12 is relatively stable to both atmospheric oxygen and heat when in acidic solution. However, the stability of vitamin B12 is significantly influenced by the presence of other vitamins. A similar observation is true for Vitamin B6 (pyridoxine), which is added to soft drinks as pyridoxine hydrochloride. Although relatively stable, its decomposition may be
Fat Soluble Vitamins

The vitamins A, D and E are not readily soluble in an aqueous medium, and detailed analytical work is required during the product development stage to ensure that these vitamins can be introduced at the required levels in a water-based product. On the flip-side, they are much easier to incorporate into products with a fat content. Vitamin A can be added as either retinol (usually as retinyl palmitate) or as \( \beta \)-carotene. Retinol, its esters and \( \beta \)-carotene are all sensitive to oxygen, light and acid media. Hence products containing vitamin A should be protected from light and the headspace air needs to be kept to a minimum. These vitamins are added routinely to food and cosmetic products where there are no issues of solubility, and where packaging can protect against light sensitivity. A low pH will also degrade folic acid and cause the hydrolytic cleavage of pantothenic acid (usually added to soft drinks as calcium pantothenate).

Research has shown that the stability of vitamin C varies widely according to the composition and oxygen content of the product. Traces of metal cations such as copper and iron can also act as catalysts to the oxidative degradation of ascorbic acid. pH and light also have an effect on ascorbic acid degradation such that the loss of vitamin C during processing can be quite considerable.

Other Ingredients

There are of course, many other ingredients that have perceived health benefits, although not necessarily proven, and not in receipt of approval from EFSA. Ingredients, such as taurine, choline, glucosamine, carnitine, carotenoids, glucuronolactone and others, are all subject to the same issues as vitamins in respect of stability and formulation challenges.

Stability is always a complex issue and nothing can be taken for granted. It is possible for an ingredient to be stable in a product when packaged in a ‘large’ bottle but less stable in a smaller bottle, simply because the proportion of headspace air to product is greater in the smaller bottle and therefore more able to react with the contents. It is only through testing that these factors can be revealed.

**ANALYTICAL TECHNIQUES**

Modern methods of liquid chromatography mass spectrometry (LC-MS) have greatly improved the analysis of vitamins, and many other ingredients, particularly in terms of speed. Although, the more traditional microbiological methods for vitamin analysis are still used in some laboratories, the results take longer to acquire and often require replicate samples to overcome potential problems from contaminants. Hence, as method development continues, it is anticipated that increasingly more manufacturers will move over to LC-MS methods for the analysis of vitamins, for reasons of speed and convenience.

The use of LC-MS has already brought progress, by making it possible to screen for multiple vitamins in one run. It also permits detection of degradation products that might otherwise go unnoticed. Indeed, the investigative team in RSSL’s Functional Ingredients laboratory has encountered previously unseen, and unexpected chemical transformations involving vitamins that change the perspective on stability. Customer confidentiality prevents giving too much detail, but what the LC-MS results have indicated is that some vitamins during processing may be converted to ‘pre-vitamin’ forms that have the potential to change back into the ‘active’ state. Whereas methods that are only able to detect the active form would report degradation/loss of the vitamin, the LC-MS method reveals that the degradation of the vitamin (and by implication, other active ingredients) may not be quite so clear cut.

**MAKING THE RIGHT CHOICES**

Deciding how much of an ingredient to add in order that label claims can be substantiated at the end of product shelf life is largely a process of trial and error, though an experienced formulation scientist can greatly facilitate the process. They can also help prevent other formulation problems arising, for example, avoiding damage to some other aspect of the product, such as its flavour profile or microbiological stability, which the addition of some new ingredient might otherwise bring about.

Indeed when any new ingredient is added to a product that is already familiar...
to consumers, it may take significant formulation expertise to give
the new product similar flavour, texture and performance
characteristics as the established brand. This can be as true in the
case of functional ingredient supplementation as it is for the
addition of other ingredients.

CONCLUSION

Even from this brief overview it is clear that the chemistry affecting
the stability of ingredients is complex, and minor modifications to
the formulation, packaging or storage of products can have a major
impact on the stability of the ingredients they contain. It’s equally
true that adjusting formulations to preserve the stability of these
new ingredients can have an impact on other aspects of the
product’s taste, quality or safety, so there is never an easy route to
product fortification.

What is certain is that the chosen route, easy or otherwise, must
include stability studies. And it is sensible to include them as soon
as possible in order to reduce the time taken to get the new product
to market, and to avoid potential problems once the product is out
on the shelves.
INTRODUCTION: THE POWER OF YEAST

Yeast (Saccharomyces cerevisiae) is a fantastic bioreactor that has been part of human nutrition since the dawn of our civilizations, as the Egyptian used it to leaven bread or ferment grape juice into wine. Today, its nutritional qualities are well recognized and yeast has grown popular with health conscious consumers and vegans, as a natural source of essential minerals, vitamins, in particular B-complex vitamins, co-factors, proteins etc. As a leading expert and producer of yeast since the end of the XIXth Century, Lallemand has developed over the years a strong portfolio of high quality yeast-based vitamins and minerals to capitalise on yeast nutritional and health-promoting power: LALMIN®.

LALMIN® is a range of inactivated whole cell yeast ingredients containing standardised and elevated levels of specific vitamins and minerals: Vitamin D, B-complex vitamins, Selenium, Zinc, Iodine, Chromium, Manganese, Magnesium etc. In order to answer specific markets needs, Lallemand has now developed a line of customised LALMIN® solutions. For example, LALMIN® Combi is a multi-vitamins and minerals ingredient suitable for various positioning: in adults, children, or seniors. It comprises of LALMIN® B-Complex vitamins, LALMIN® Se, LALMIN® Zn, and LALMIN® Chromium. The following sections detail some examples of tailored LALMIN® solutions designed for specific targets.

Selenium is an essential micronutrient which plays an important role in cell-mediated immunity, and has been shown to strengthen the immune response. LALMIN® Immune contains a natural source of selenium: LALMIN® Se, an inactivated whole cell yeast rich in bioavailable selenium. Selenium yeast has been recognised by EFSA as the most bioavailable source of selenium for human nutrition (1).

Certain studies have linked high occurrence of flu during the winter to vitamin D deficiency, and several European surveys have shown that up to 75% of the European population’s vitamin D intake could be below the recommended daily allowances (RDA). The Vitamin D provided by LALMIN® Immune is not synthetically produced but “yeast-made” LALMIN® Vita D. LALMIN® Vita D is an inactivated dried whole cell yeast containing elevated and standardised levels of vitamin D2, produced thanks to a

IMMUNITY

LALMIN® Immune combines the complementary immune and antioxidant properties of yeast-based selenium and Vitamin D to activated yeast beta-gluccans.

SUMMARY

Yeast (S. cerevisiae) is widely recognised for its nutritional qualities and has been part of our diets for millennia. Not only a source of valuable nutrients, yeast represents also an excellent vitamins and minerals “processing plant”. Lallemand, an expert in yeast production, has taken advantage of this feature to develop a range of quality yeast-based bioavailable vitamins and minerals: LALMIN®. Today, the company is widening its offer with customised LALMIN® solutions to target specific markets and applications: immunity, nutricosmetics, detox, sport, seniors, women nutrition...
unique process involving the conversion by yeast cells of natural endogenous ergosterol in presence of light.

Moreover, there is an increased need for antioxidant nutrients during infections, in order to prevent local oxidative injury. To complement selenium recognition anti-oxidative potential, LALMIN® Immune is also a source of yeast beta-1,3/1,6-glucans, whose powerful antioxidant activity has been shown to protect cellular integrity from oxidative injury following an excessive activation of the immune response (2). Yeast cell wall beta-glucans are generally recognised for their immunomodulating effects and beneficial health effects. They also have a strong antioxidant power. The yeast cell wall beta-glucans used for the production of LALMIN® Immune, called Glucans 30, contain standardised levels of activated (exposed) beta-1,3/1,6-glucans.

LALMIN® Immune is formulated so that 350 mg contains: 100% RDA selenium; 100% RDA vitamin D; and 270 mg of activated yeast beta-1,3/1,6-glucans.

**BEAUTY FROM WITHIN**

Yeast is among the natural ingredients for which the link with radiant skin and hair is well known, mainly due to its high level of B-Vitamins. LALMIN® Beauty has been developed to tap into the emerging Nutricosmetic market. It contains standardised levels of bioavailable minerals: LALMIN® Se and LALMIN® Zn, combined to LALMIN® B-Complex Vitamins.

Selenium, which also bears an anti-oxidant Article 13.1 health claim, has been granted in 2010 ‘beauty claims’ concerning hair and nails. Selenium hair and nails benefits are based on the observation of selenium deficiency symptoms such as impairment of nail and hair. Moreover, selenium is known to protect the skin against UV-radiations. A human study (3) has shown the sun-protection potential of an antioxidant complex containing LALMIN® Se. The authors found that the supplement significantly increased skin tolerance to UV-light in volunteers. Melanin production and skin coloration were also enhanced. In parallel, the authors showed a significant reduction of UV-induced oxidative stress in skin.

Zinc is involved in collagen and keratin synthesis and possesses antioxidant properties, hence its importance in skin, hair and nail development and maintenance. Zinc potential in skin, hair and nail health has prompted EFSA to grant the mineral article 13.1 health claims related to the maintenance of hair, skin and nails. When it comes to zinc

supplementation, zinc yeast offers optimal bioavailability. Bioavailability studies have shown that LALMIN® Zn had a higher bioavailability than equivalent doses of gluconate zinc. In a comparative clinical study in healthy volunteers, it was shown that protein-bound zinc brought by LALMIN® Zn supplement enabled better zinc uptake and retention by the body than zinc gluconate (Figure 1) (4).

B-complex vitamins are essential for hair and skin development and health. Yeast represents a major reservoir for B Vitamins, when compared to other dietary sources. However, it is very difficult to guarantee consistent levels of B-complex vitamins in breeder’s by-products and even baker’s yeast. LALMIN® B-Complex vitamins is a yeast-based ingredient standardised in elevated and fixed levels of the B vitamins in order to guarantee a consistent, high level of the 8 B-complex vitamins: B1, B2, B3, B5, B6, B8, B9, B12. LALMIN® Beauty is formulated so that 500 mg represents 50% of the recommended daily allowance for Selenium, Zinc, and B Vitamins.

**SPORT AND VITALITY**

Sport nutrition is a rapidly growing market and the demand is strong, not only from athletes but also from the general public, for energy and vitality promoting supplements. LALMIN® Vitality combines LALMIN® B-Complex Vitamins to yeast nucleotides. B vitamins are essential for the body energy and nutrient metabolism. Moreover, B-Complex Vitamins are recognised to contribute to the reduction of tiredness and fatigue. It has been shown in an animal bioavailability study that the bioavailability of Vitamin B1 is superior with LALMIN® B Vitamins than with a synthetic blend of B vitamins (Figure 2). It is hypothesised that the benefit of the yeast-based Vitamin B supplement vs. a synthetic blend of B Vitamins could be due to the interaction in this ingredient between the added B vitamins and the yeast components, yeast being recognised as a good source of B Vitamins (unpublished results). Vitamin B1 (Thiamin) is known to play a fundamental role in energy metabolism and in the metabolism of glucose.

Nucleotides can be generated by the organism. However, under certain circumstances (e.g. in the sub-well, diseased, or under conditions of stress or poor diet) dietary nucleotides can be considered as “semi-essential”. Dietary nucleotides supplementation has been shown to have important effects on the growth and development of cells which have a rapid turnover such as those in the immune system and the gastrointestinal tract. In training athletes, improved immune function has been observed following nucleotides supplementation (5). More recently, McNaughton et al., in two trials (6,7), showed that dietary nucleotides supplementation increased salivary IgA post exercise in athletes. IgA is found in saliva where it constitutes the first line of defence against upper respiratory tract infections and it has been shown to be reduced in endurance exercise. Thus the supplementation with a source of readily available nucleotides
during physical efforts is important.

LALMIN® Vitality/Sport is formulated so that 500 mg represents 50% of the recommended daily allowance for B complex vitamins and 250 mg of nucleotides rich yeast extracts.

**DETOX**

Lalmin Detox is a rich source of natural antioxidants and molecules with detoxifying properties: LALMIN® Se, glutathione and yeast beta-1,3/1,6-glucans (Glucan 30).

Selenium and Glutathione are both parts of one of the cell’s natural antioxidant strategies: the glutathione peroxidase enzymatic pathway (Figure 3). Glutathione peroxidase reduces hydrogen peroxides, preventing further oxidative reactions in the cell. The glutathione peroxidase activity depends on glutathione as a co-factor, which becomes oxidised in the form of glutathione disulphide. Regeneration of glutathione involves another enzyme: a glutathione reductase. The glutathione peroxidase enzyme contains four atoms of selenium in the form of selenocystein amino acids. It has been shown that the antioxidant activity of the glutathione peroxidase depends directly on the dietary supply of selenium. Insufficient selenium supply from food leads to a decrease of the protective glutathione peroxidase activity.

LALMIN® Detox is formulated so that 500 mg represents 100% of the recommended daily allowance for glutathione and selenium. Additionally, it can also include activated yeast beta-1,3/1,6-glucans.

**SENIOR-SPECIFIC SUPPLEMENTS**

In order to address senior health in particular, this specific formula combines LALMIN® Vita D and LALMIN® B-Complex vitamins.

Vitamin D is essential to many body functions and consumers and doctors have recently become increasingly aware of its many health benefits, while Vitamin D deficiency is regularly invoked, particularly under Northern latitudes and due to modern lifestyle. The principal function of Vitamin D is to maintain intracellular and extracellular calcium concentrations within a normal range by regulating calcium and phosphorus metabolism in intestines and bones. Vitamin D is widely recognised for its important role in the prevention of osteoporosis. A recent animal study has demonstrated that Lallemand’s Vitamin D2 made from yeast has similar bioavailability to synthetic Vitamin D3 and was able to improve bone health markers: mineral content and density, geometry, volume and connectivity density (8). In addition growing evidence suggests that vitamin D also helps boost the immune system, reduce inflammation, and maintain muscle strength. Furthermore some studies suggest that vitamin D may help in the prevention of several chronic diseases such as cancer (especially breast and colorectal cancer), diabetes, multiple sclerosis, hypertension, arthritis, heart diseases and even infectious diseases such as influenza.

Vitamins B (folic acid and B12) have been linked to cognitive decline prevention. In Haan study (9), a link has been drawn between high vitamin B12 blood levels in elderly subjects and reduced cognitive decline and dementia risks. In 2007, Dr. Durga summarised a study published in _The Lancet_ (10): “In 818 older adults, daily oral folic acid supplementation for three years beneficially affected global cognitive function, and specifically memory and information processing – functions that are sensitive to ageing." Moreover, a six-year follow-up study conducted by Columbia University in New York showed that increased dietary folic acid intake was associated with a 50% reduction in Alzheimer’s disease risk (11).

LALMIN® Senior is formulated so that 350 mg represents 50% of the recommended daily allowance for B Complex vitamins and Vitamin D.

Altogether these customised LALMIN® solutions allow to capitalise on yeast natural power to target specific markets and applications. These ingredients are readily available for food supplements. They offer the LALMIN® experience and seal of quality (safety, traceability, standardised concentrations), coupled to the natural benefits and image of yeast.

**REFERENCES**

One of the biggest barriers to people staying healthy and fit (aside from motivation) is physical pain. Whether it is something chronic, or simply the result of age or poor exercise recovery, people generally don’t want to do any activities they know won’t make them feel good. At least, not feel good right away.

Unfortunately, many of the pain-relieving products we take to feel better actually take a toll on our health overall. They can wear away the lining of the stomach, damage the liver, and create a ‘feedback loop’ in which the more of the drug you take, the more you need because it actually starts causing pain or muscle aches.

There is a much better way. It’s a combination of BCM-95® Curcumin and a high-AKBA BosPure® boswellia, along with two ingredients you might not usually support with an active life. The first two botanicals in that list, curcumin and boswellia, have been part of Ayurvedic medicine for generations. They have also both benefited from some very real advances, too.

Let’s look at curcumin from turmeric first.

The plant turmeric is very well known in India. The root is harvested, cleaned, dried, and powdered to be used as a spice (turmeric gives curry its beautiful golden yellow color) and as a medicine. Traditionally, turmeric was used for nearly every health condition known – from smallpox to a sprained ankle. The reason for its health effects is the compound known as curcumin. Just as oranges are a source of vitamin C, turmeric is a source of curcumin. Today, we extract curcumin from turmeric to use as a natural medicine (1).

The majority of turmeric products on the market are regular extracts, standardized to 95% curcumin. Unfortunately, this extract of curcumin is poorly absorbed, so it doesn’t pass easily from the gastrointestinal tract into the bloodstream. And, much of the curcumin that does reach the bloodstream quickly converts into other compounds.

There have been many attempts to make curcumin more absorbable and have it remain in the bloodstream longer so it can be more beneficial. Animal and lab studies have shown curcumin to be highly effective for support of immune and liver function, as a powerful antioxidant assuring healthy inflammation response, and as a natural pain relieving substance. So it has always had the potential to be extremely effective for many health concerns.

However, human absorption has been more challenging. Current research has focused on tuning this around. One company, Ayura of Kerala India, has been very successful, with a brilliant natural solution. It combines curcumin with turmeric essential oils to ensure both high absorption and extended blood retention time. In fact, the blood retention – the time when this extract can be truly useful by the body, not just absorbed – has been shown to be a minimum of 8 hours and in some cases up to 12 hours! So it truly shows the best of both worlds – high absorption – up to 10 times that of standard 95% curcumin extracts – with high blood levels, and no side effects. That’s why BCM-95 Curcumin is the best choice to support metabolic functions throughout the body (2,3).

Curcumin in general and BCM-95 in particular, has incredible healthy inflammation response. That means its benefits can go beyond pain relief – although that is a major benefit. That’s because a majority of chronic and acute have one thing in common – oxidative stress caused by free radicals and inflammation. Free radicals and inflammation go hand in hand. Inflammation damages cells and tissues by creating free radicals. Free radicals damage cellular DNA and weaken our immune system. Chronic inflammation combined with a weakened immune system is extremely dangerous. Experts have estimated that free-radical damage contributes to more than one-third of all deaths and about 40% of total medical expenses in industrialized countries.

The key to preventing and treating illness is to use a multifaceted approach. Rather than influencing just one pathway, as most drugs do, curcumin has 112 different molecules which simultaneously influence multiple pathways on multiple levels.

In an era when new technology is being used for many types of foods and supplements, I do think it’s important to remember that as advanced as BCM-95 is, it is also a natural source of curcumin and turmeric essential oils which has been used as a food for over 5,000 years. It doesn’t include any unproven substance or ingredient that has been untested or may be potentially harmful.

Boswellia is another herb that works extremely well synergistically with curcumin. It is especially effective and potent at reducing joint pain associated with arthritis by inhibiting the inflammatory enzyme, 5-LOX. BosPure®, the specialized high-AKBA (acetyl-11-keto-β-boswellic acid) boswellia in conjunction with curcumin, is low in
INFLAMMATION

CLINICALLY TESTED POWER AGAINST PAIN AND INFLAMMATION

BCM-95® Curcumin has been featured in published clinical studies concerning pain and inflammation. One study used a combination of BCM-95® and high-AKBA boswellia in a study of osteoarthritis relief. The other, focused on rheumatoid arthritis (RA) used BCM-95® alone.

The osteoarthritis study compared the two botanicals to a generic cocomidex (known under the brand name Colebrex®) for individuals with osteoarthritis. One group received cocomidex, 100 mg, twice daily while the second group received a 500 mg blend of the BCM-95® curcumin and the high-AKBA, low-beta boswellia extract twice daily. When it came to relieving pain, 64% of those taking the herb combination versus 29% in the drug group improved to such a high degree that they were able to move from having “moderate to severe arthritis” to “mild to moderate arthritis” (6).

The RA study followed 45 individuals, randomized to three groups. Group one received diclofenac sodium, 50 mg, twice daily; group two received 500 mg BCM-95 Curcumin twice daily; and group three received both diclofenac sodium and BCM-95 Curcumin. In the BCM-95 Curcumin groups, there were no drop outs due to adverse effects, but in the diclofenac sodium group, 14% withdrew due to adverse effects. In the Disease Activity Score (known as “DAS”) 28 assessment, BCM-95 curcumin had the highest impact for reducing disease symptoms, followed by the combination therapy of BCM-95 curcumin with diclofenac sodium. Interestingly, the diclofenac sodium-alone group scored in last place (7).

One of the reasons curcumin is such an effective anti-inflammatory agent is because it is a potent antioxidant as well, protecting the body while fighting inflammation. Vitamin D3 and boron, along with BCM-95 Curcumin and high AKBA boswellia, deserve special mention especially for joint and joint support. Vitamin D3 is an amazing nutrient for body and mind, and is already well-known for its ability to support bone health. Even better news is that studies show vitamin D3 also helps build the cushioning cartilage between joints (8).

Some exciting new research shows a relationship between arthritis, joint health, and vitamin D deficiency. In fact, vitamin D deficiency was noted in 69% of the patients with inflammatory joint diseases or connective tissue diseases, 77% with soft tissue rheumatism, 62% with osteoarthritis, 75% with back pain, and 71% with osteoporosis (9).

Of course, for years the recommended level of vitamin D intake was set way too low. We’re just beginning to see conventional medical practice catch up with the idea that many people – perhaps most of us, especially in northern climates with long winters – are deficient in vitamin D.

It’s common for older individuals to be deficient in vitamin D. Another recent study examined serum vitamin D levels in postmenopausal women. As it turned out, 53% of the women were deficient in vitamin D, and only 17% had sufficient blood levels of the nutrient. Joint pain and joint swelling were reported, (74% and 34%, respectively). Typically, those with the lowest levels of vitamin D showed a higher average joint pain score. These are some of the reasons why vitamin D3 should be included in a formula for osteoarthritis of the knee (10).

But beyond pain, vitamin D is associated with stronger knee cartilage – the cushioning “shock absorber” of our joints. Another recent study showed a correlation between sunlight exposure (which helps our bodies synthesize vitamin D on our own), serum levels of vitamin D, and the loss of knee cartilage. The authors of the study concluded that sufficient vitamin D levels might prevent – or at least slow down – osteoarthritis-related cartilage loss in the knees. One of the challenges they noted was that vitamin D intake levels and serum levels didn’t always correspond. This can be due to a lot of factors, including absorption and metabolic disorders. But despite that, I think that this also shows the importance of having supportive ingredients in combination; you can’t always rely on a single nutrient to do all of the heavy lifting.

This is where boron comes in. In a pilot study with volunteers with vitamin D deficiency, this specialized form of boron found naturally in fruits and vegetables raised the serum vitamin D level.

Fructoborate, a form of boron found naturally in fruits and vegetables, has been clinically shown to reduce joint pain in volunteers suffering from mild to moderate osteoarthritis. Additionally, it helps the body absorb and use Vitamin D3, which helps build bone – and much more. It also boosted levels of DHEA (dehydroepiandrosterone), a hormone that supports the adrenal glands and can boost energy levels and generally help you feel healthier (11). Additionally, this amazing form of boron reduced joint pain, stiffness and inflexibility in volunteers with severe osteoarthritis in just 8 weeks (12).

One of the reasons that boron can have this ability is that it keeps bone and joint building activity proceeding normally. Generally speaking, boron supplementation isn’t always very beneficial, because boron just isn’t that selective about which molecules it combines with in the body. It needs to be combined with another compound that helps the boron absorb to the tissues that need it most. Boron carbohydrate complexes like fructoborate are just such a combination.

GET THE BEST RESULTS WITHOUT THE SIDE EFFECTS

If you can get the same benefits of an over-the-counter or prescription drug without the side effects and health risks, why wouldn’t you want an effective, natural alternative? The ingredients I’ve discussed here are proven and natural. With BCM-95® curcumin, BosPure® boswellia, vitamin D3, and boron, you can have an active life without compromising your health or your busy life in the process. Sounds like a winning situation all-around!

REFERENCES

11) Pilot clinical trial of fructoborate in vitamin D deficient human volunteers; Data unpublished.
12) Department of Orthopedic Medicine, University of Novi Sad, Serbia; Data unpublished.
ARISTA INDUSTRIES
For over 80 years, Arista Industries has been a leading supplier of top-quality Oils, Butters and Oil Powders. Green Coffee Powder is just being introduced as an effective ingredient in appetite suppressants. Cod Liver Oils and Fish Liver Oils are offered containing various Vitamin A and D potencies.

CAROTECH
Carotech is the first GMP-certified producer in the world of natural full spectrum tocotrienol complex (Tocomin® and Tocomin SupraBio®), natural mixed carotene complex (Caromin®) and phytosterol complex (Stelessterol™). These products are non-GMO, Kosher and Halal. Tocomin SupraBio® is a patented self-emulsifying palm tocotrienol complex that ensures optimal tocotrienols oral absorption – for neuroprotection, heart health and liver support.

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• Flaxseed Extract with Lignans SDG;
• 5-HTP;
• Trans-Resveratrol;
• Blueberry Extract with Anthocyanidins;
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SAFIC ALCAN
Safic Alcan is a French distributor of actives for the health and nutrition market. Our range consists of selected raw materials, with either claims approved by the EFSA or supported by relevant and comprehensive clinical trials, like Vitamin K2, Chitosan, Fucoidan, Colostrum and Beta-Glucan. Besides, through our long-lasting expertise in sourcing we might help you finding the ingredients you need in all your developments and innovative projects.

NUTRI-FACTS – AN ONLINE INFORMATION SOURCE ABOUT VITAMINS AND MORE
DSM Nutritional Products has developed the Nutri-Facts website, a non-commercial high-quality online information source about health impacts, requirements and safety of micronutrients. Nutri-Facts offers the latest scientific news and established facts about essential micronutrients as well as background information on study results and expert comments in multiple languages. All the content is documented with references and quotations, and does not simply reflect the opinion of a company. Due to the site’s highly respected and independent view, many food, beverage and supplement companies use Nutri-Facts successfully for their consumer relation activities.

www.nutri-facts.org
AMWAY RECOGNIZES SCIENTISTS WITH HIGHEST R&D HONOR

From developing the next generation of vitamins to advancing the formulations of everyday beauty and household items, the Amway Research and Development (R&D) staff is making a notable impact on the way people live worldwide. Now, four Amway scientific leaders are being recognized for their efforts by being inducted into the new Amway R&D Distinguished Scientific Leadership Society, achieving the division’s highest possible level of technical recognition. The first society inductees include:

- **Eenie Brumbaugh** – A pioneer in the development of new technologies, Brumbaugh has been creating innovative Amway™ products for more than four decades. He’s known for his breakthrough launch of the first non-chlorinated automatic dish detergent on the market in the 1980s and his recently patented discovery that makes several cleansing products gentler on the skin. His efforts enhance the position of Amway as a leader in the home products category.

- **Amit Chandra, Ph.D.** – With a strong track record of breakthrough scientific efforts advancing the Nutrilite® brand, Chandra’s technical excellence has resulted in nine patents, six published papers, 28 posters and presentations, and multiple industry awards during his time at Amway. He is well-known for his work in botanical fingerprinting that ensures consistent quality in vitamin and supplement products.

- **Tom Hamernik** – Well-known for his significant contributions in the global regulatory environment on behalf of Amway, its Artistry® brand, and generally in the home product category, Hamernik also has a distinguished record of leadership in industry organizations such as the Personal Care Products Council (PCPC).

- **Keith Randolph, Ph.D.** – A leader of the company’s nutritional efforts, Randolph has focused great effort on developing the next generation of nutritional products for the Nutrilite® brand. He is a leader in the scientific industry, serving as the chair of multiple scientific committees and a headline speaker at many technical conferences.

“Each of these inductees has accomplished outstanding technical achievements and exemplifies the highest standard of behavioral competencies as a mentor, collaborator and advisor,” said Catherine Ehrenberger, vice president of R&D at Amway. The Amway R&D Distinguished Scientific Leadership Society was created to acknowledge individuals with a longstanding record of scientific and technical excellence during their Amway career. Inductees were nominated independently by a member of management and endorsed by the R&D executive leadership team. The criterion for selection included demonstration of technical credibility through past awards, patents, and publications, significant impact in the areas of innovation, scientific leadership, experimentation, mentoring and collaboration, and a tenure of at least 10 years at Amway.

DSM AND SIGHT AND LIFE LAUNCH ‘VITAMINS IN MOTION’ CAMPAIGN AT HIDDEN HUNGER CONGRESS

Experts in the fields of nutrition and development gathered at the international Hidden Hunger Congress last March to address the global crisis of chronic micronutrient deficiencies, also known as hidden hunger. At this multi-stakeholder event, DSM and Sight and Life launched their Vitamins in Motion campaign, an initiative to raise awareness and advocate for increased access to the essential vitamins all people need to be healthy and well-nourished.

“Vitamins have the power to unlock human potential in both the developed and developing world,” said Dr. Manfred Eggensperger, Senior Vice President and Head for Nutritional Science Advocacy at DSM Nutritional Products. “DSM and Sight and Life are committed to putting Vitamins in Motion. Whether it’s discovering new scientific breakthroughs in the lab or building partnerships to deliver micronutrients to the world’s most vulnerable populations, we are on the front lines of the global fight against hidden hunger.”

Hidden hunger exists globally, in both developing and developed countries. Some two billion people worldwide cannot access or afford enough nutritious food, and therefore live with a chronic shortage of vital micronutrients. Even in the wealthiest countries, shifting patterns of diet and lifestyle are leading to poor nutrition, which is linked to rising rates of obesity and costly non-communicable diseases like diabetes, stroke and heart disease.

“Micronutrient interventions like vitamin supplementation and food fortification improve health, save lives and increase productivity. Vitamins in Motion aims to highlight this critical role vitamins play in overall nutrition and health, and calls for finding and implementing solutions to address the world’s vitamin deficiencies,” said Dr. Klaus Kraemer, Director of Sight and Life.

DSM and Sight and Life have a long history of combating micronutrient deficiencies around the world and have a number of partnerships including with the UN World Food Program that has provided more than 15 million people with improved nutrition since 2007.

BASF INCREASES PRICES FOR VITAMIN A FEED GRADE

BASF has increased prices for Vitamin A products for animal nutrition by 9.6% globally. Existing contracts will be honored. BASF is a leading producer of Vitamin A for the animal nutrition industry worldwide. The company is a global leader in sustainable animal nutrition – offering vitamins, carotenoids, enzymes, organic acids, and specialties for all types of feed. BASF’s products are mainly fed to ruminants, poultry, pigs, farmed fish, and companion animals. Innovative products (such as Natugrain® TS), modern technologies (including white biotechnology), and SET, BASF’s initiative for applied sustainability, pave the way for making animal nutrition not only more efficient and cost-effective, but also more sustainable. BASF’s expert teams help the nutrition industry analyze and systematically improve the efficiency and sustainability of its products and make verifiable value propositions to the entire value chain up to and including consumers.

Essential Food is an organic barley based nutritive formula. It's just one of G&G's high quality natural supplements.

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