



We create chemistry

Natuphos[®] E

The phytase pioneer is setting new benchmarks



-
- Maximum phosphorus savings
 - Exceptional process and storage stability with hybrid 6-phytase
 - Improved feed utilization and sustainable use of resources
-

The science of sustainable feed that succeeds

More than

★ **30** ★
YEARS

Pioneering Expertise
BASF Enzymes

animal-nutrition.basf.com

Natuphos® E: unprecedented phytase from BASF

As the first company to market a phytase for feed almost 25 years ago, BASF is once again proud to be setting a new standard in feed phytase technology. Our unprecedented new phytase Natuphos® E sets a new benchmark in the market, from which our partners in the feed industry can benefit.

Novel hybrid technology

Natuphos® E is a preparation of a bacterial-derived 6-phytase [EC 3.1.3.26] produced by our proven *Aspergillus niger* technology at BASF headquarters in Germany. This novel enzyme molecule is of bacterial origin and was created using a unique enzyme engineering method. A hybrid enzyme was created from three bacterial sources (Figure 1). The new technology results in unprecedented enzyme stability. It has been specifically designed to break down phytate and its complexes present in plant-based ingredients in pig and poultry diets at the required location in the gastrointestinal tract. Natuphos® E ensures a very fast and efficient release of phytate-bound phosphorous, which is of considerable value to the global feed industry.

Stability boosts performance

Thanks to its hybrid enzyme-molecule, Natuphos® E provides exactly what users in the feed industry want. The new molecule demonstrates unprecedented overall stability in challenging environments – be it in the animal gut, in premixes, in feed or during pelleting processes. Natuphos® E is powerful at resisting pepsin, adverse pH-conditions and high temperatures. The excellent shelf life stability additionally contributes to the outstanding stability profile of Natuphos® E. This outstanding stability ensures an excellent performance.

Good choice for economy and environment

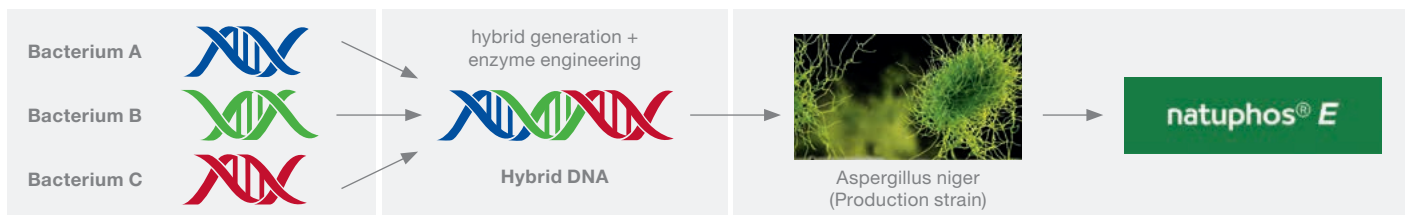
The efficient phosphorous release provides tangible benefits – for feed mixers, integrators as well as the environment. The unique feature of Natuphos® E – its exceptional stability based on the new molecule – is reflected in sustained high enzyme activity, optimal utilization of nutrients in the feed and sustainable use of resources. The use of Natuphos® E also reduces the excretion of phosphorous with positive implications for the environment.

All these great attributes, which are built on more than 30 years of phytase experience, are reflected in our Natuphos® E slogan: “Efficient by Experience”

Natuphos® E in practical applications

On the basis of large numbers of experiments, Natuphos® E can now be incorporated in linear optimization as a feed ingredient. This makes it possible to save the quantities of nutrients (P, Ca, amino acids, energy), which Natuphos® E liberates from the phytate complex. If broiler feed is supplemented with 350 FTU/kg, it is possible, e.g., to reduce DCP supplementation by 6.4 kg/metric ton of feed.

Figure 1: Novel hybrid 6-phytase



Additional benefits for our customers

Reliability is part of our business

Products by BASF Animal Nutrition are precisely developed and renowned for high quality and consistency. Our technical support and recommendations for the use of Natuphos® E are based on sound scientific evidence, technical know-how and close interaction with our customers. This contributes to the recognized reliability of our matrix values. Our high-quality phytase product Natuphos® E is complemented with services and our application expertise.

Readily mixable with other enzymes like Natugrain®

All Natuphos® E formulations can be readily mixed with nonstarch polysaccharide (NSP) enzymes. The unique 3-in-1 combination product Natuphos® E 5000 Combi G/L is a mixture of Natuphos® E (hybrid 6-phytase) and Natugrain® TS (endo-1,4-xylanase and endo-1,4-beta-glucanase) and facilitates stock management and application by enabling you to use one additive instead of two at the inclusion level of only one.

Last but not least: The BASF Service Portfolio

We offer our customers application expertise through our global and regional technical as well as business support teams. We can provide analysis of feed enzymes containing premix, base mix and compound feed samples in BASF enzyme laboratories.

We can also support with a quantitative and reliable enzyme assay; approved by the International Organization for Standardization (ISO) and the Association of German Agricultural Analytic and Research Institutes (VDLUFA).

Finally, our stringent end product monitoring ensures a consistent high product quality. We are a certified Fami-QS supplier and comply with a comprehensive set of standards, including ISO 9001, ISO 14001, and ISO 5001.



Unique values of Natuphos® E benefiting our customers

The benefits of Natuphos® E for users in the feed industry are numerous. Most importantly, they can save on the addition of inorganic phosphorous. We offer a product with a reliable performance because of its exceptional product stability. Natuphos® E has a superb product shelf life - 24 months for solids (granulates/powder) and 18 months for liquid grades, which demonstrates its exceptional intrinsic stability.

A long product shelf life provides flexibility in logistics and trust in product performance. Natuphos® E combines three exceptional values within one product:

- Highly efficient phosphorous release
- Superior pelleting and premix stability
- Long-term shelf life stability

Intelligent choice for those seeking performance

1. Superb resistance against digestive enzymes in the animal gut, an optimal fit to pH conditions

Phytase-mediated phosphorous release mainly takes place in the upper digestive tract of pigs and poultry. Here, the physiological pH ranges from 2.0 to 5.5. Figure 2 clearly shows that the optimum activity of Natuphos® E matches this targeted pH range perfectly.

Natuphos® E shows superior resistance to pepsin, the main protein-degrading enzyme in the monogastric's stomach (Figure 3). Both features allow the highly efficient decomposition of anti-nutritive phytate already in the very beginning of the digestive tract and maximize the time available for the animal to absorb the nutrients that would otherwise remain bound to and complexed with phytate.

2. Higher feed energy value through improved nutrient utilization

Natuphos® E maximizes the efficient release of dietary phosphorous from phytate, thus making it readily digestible for pigs and poultry.

The ability of Natuphos® E to maximize the release of phytate-bound minerals, amino acids, and its large improvement of feed energy value has been verified and quantified in many feeding trials in all relevant species with widely varying diets. The high potential for energy and nutrient replacement offers unrivalled potential for feed cost savings, while ensuring at least equal performance parameters compared to the non-Natuphos® E supplemented standard diets.

3. Setting new sustainability standards

Natuphos® E supports nutrient digestion and sets new standards for more sustainable livestock production. The use of our unrivalled phytase increases resource efficiency, minimizes environmental impacts, and reduces the required quantity of raw materials like minerals.

This is generated by an increase in the digestion efficiency of phosphorous. Lower or no supplementation of mineral phosphorous (depending on the diet) is needed to cover the requirement of the animals. The release of phosphorous, protein, amino acids, and energy, results in improved nutrient utilization and reduced phosphorous excretion. In this way Natuphos® E is a contribution to more sustainable production and proves the guiding principle of preserving and using resources efficiently.



Resource efficiency

Less mineral phosphorous, protein, and amino acids needed as Natuphos® E improves digestion of phytate-bound phosphorous and other complexed nutrients in feed.



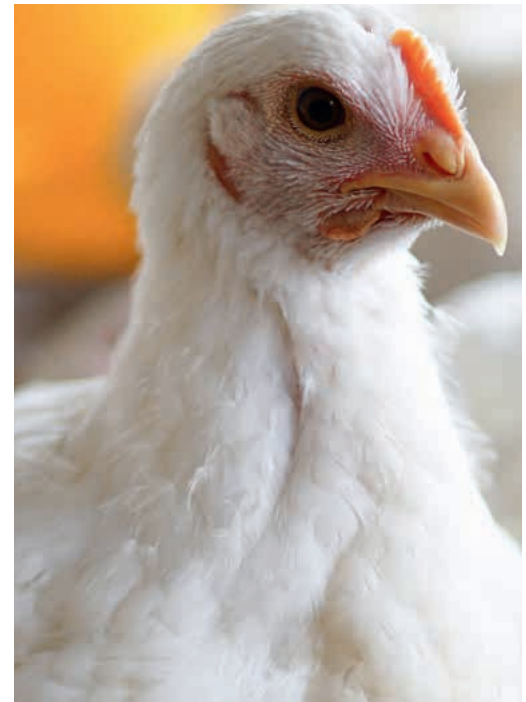
Minimizing environmental impact

Reduced eutrophication by less excretion of phosphorous.



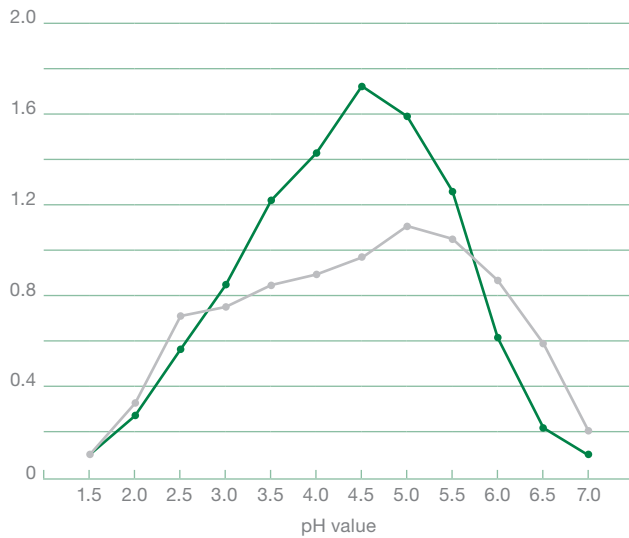
Reduced dependency on market prices

- Reduced dependency on inorganic phosphorous.
- Allows for the use of less costly by-products e.g. bran.



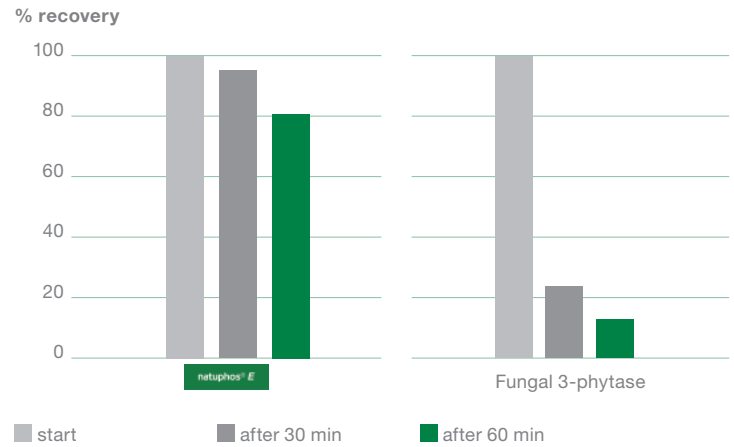
For matrix values, please contact your local BASF sales representative

Figure 2: pH profile of Natuphos® E



■ Fungal 3-phytase ■ Natuphos® E

Figure 3: Resistance of Natuphos® E to pepsin at pH 2 in vitro



Natuphos® E is highly active in an acidic environment and has exceptional pepsin resistance.



Suitable formulations for all applications

Natuphos® E is available in powder, liquid, and granulate form. These formulations cover all usual areas of application. The actual product portfolio is shown in Table 1. Products with different activities may be available upon request. Especially to be emphasized here, is the superb product shelf life of 24 months for solids (granulates/powder) and 18 months for liquid grades, reflecting the exceptional stability of Natuphos® E.



Table 1: Natuphos® E product portfolio^{1,2,3}

Product ¹	Form	Additional Information	Standard Packaging	Article No.
Phytase				
Natuphos® E 5000	Powder	Hybrid 6-phytase (5,000 FTU/g), recommended for non-pelleted feed and pelleting up to 85°C	20 kg bag in box 350 kg big bag	50411374 50411378
Natuphos® E 10000	Powder	Hybrid 6-phytase (10,000 FTU/g), recommended for non-pelleted feed and pelleting up to 85°C	20 kg bag in box	50461879
Natuphos® E 50000	Powder	Hybrid 6-phytase (50,000 FTU/g), recommended for non-pelleted feed or pelleting up to 85°C	20 kg bag in box	50471892
Natuphos® E 5000 L	Liquid	Hybrid 6-phytase (5,000 FTU/g), recommended for post-pelleting applications	125 kg plastic drum 1,000 kg bulk container	50366325 50366324
Natuphos® E 10000 L	Liquid	Hybrid 6-phytase (10,000 FTU/g), recommended for post-pelleting applications	500 kg bulk container	50682917
Natuphos® E 5000 G	Granulate	Hybrid 6-phytase (5,000 FTU/g), can be used up to 95°C pelleting temperature	20 kg bag in box	50430020
Natuphos® E 10000 G	Granulate	Hybrid 6-phytase (10,000 FTU/g), can be used up to 95°C pelleting temperature	20 kg bag in box 350 kg big plastic bag	50428731 50428732
Natuphos® E 17500 G	Granulate	Hybrid 6-phytase (17,500 FTU/g), can be used up to 95 °C pelleting temperature	20 kg bag in box 350 kg big bag	50510235 50776890
Phytase, Xylanase, Glucanase				
Natuphos® E 5000 Combi L	Liquid	Hybrid 6-phytase (5,000 FTU/g), endo-1,4-beta-xylanase (5,600 TXU/g) and endo-1,4-beta-glucanase (2,500 TGU/g), recommended for post-pelleting applications	125 kg plastic drum 1,000 kg bulk container	50425767 50425769
Natuphos® E 5000 Combi G	Granulate	Hybrid 6-phytase (5,000 FTU/g), endo-1,4-beta-xylanase (5,600 TXU/g) and endo-1,4-beta-glucanase (2,500 TGU/g), can be used up to 95°C pelleting temperature (applicable when improved version is available next yr Q1)	20 kg bag in box	50470843

1 At pelleting temperatures above 90°C, it is recommended to test for phytase retention as pelleting conditions vary greatly.

2 The contents indicated are minimum amounts of active substance.

GMO status: Our products are not subject to labelling and traceability acc. to the European regulation (EC) 1829/2003 and (EC) 1830/2003.

BSE/TSE status: The above-mentioned products do not fall under the scope of the Regulation (EC) No 999/2001 (current consolidated version), laying down the rules for the prevention, control, and eradication of certain transmissible spongiform encephalopathies.

3 Product availability is subject to country-specific product registration.

Suitable formulations for all applications

Granulates: Extraordinary pelleting stability

Our Natuphos® E granulates are off-white in color, virtually dust-free with a narrow particle size distribution (Figure 4). A homogeneous distribution in feeding stuffs can be obtained using standard mixing procedures.

The granulate formulations exhibit a superior stability and are recommended for pelleted feed, up to pelleting temperatures of 95°C (Figure 5). The hybrid 6-phytase enzyme molecule is protected by formulation using a highly sophisticated and IP-protected process, while uncompromising its release from pelleted feed in the animal.

In addition, the premix stability of Natuphos® E granulates in a typical broiler premix is excellent (Figure 6).

Powders: High pelleting and premix stability

The free-flowing powders are beige to light brown in color. The uncoated powder formulations can be used for pelleting temperatures up to 85°C, and are predominantly recommended for all mash feeds. The economically interesting formulation furthermore exhibits a good stability in base mixes and premixes (Figure 6).

Liquids: Ideal for post-pelleting application

The liquid Natuphos® E formulations are light to medium brown, clear fluids without any turbidities or suspending particles. This ensures an optimal application by post-pelleting systems onto the cooled pellets since the outstanding product quality prevents nozzle blocking at the highest level possible. Over the last two decades, BASF has gained a vast experience in installing post-pellet liquid application (ppla) systems. With appropriate equipment the liquid formulation of Natuphos® E is sprayed onto the cooled pellets. BASF can assist in sourcing these PPLA systems.

Figure 4: Natuphos® E granulates are virtually dust-free and have a narrow particle size distribution

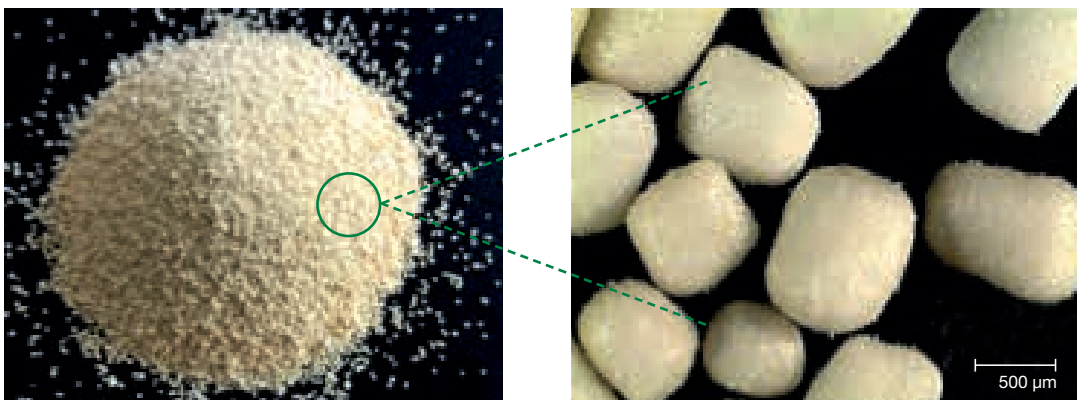
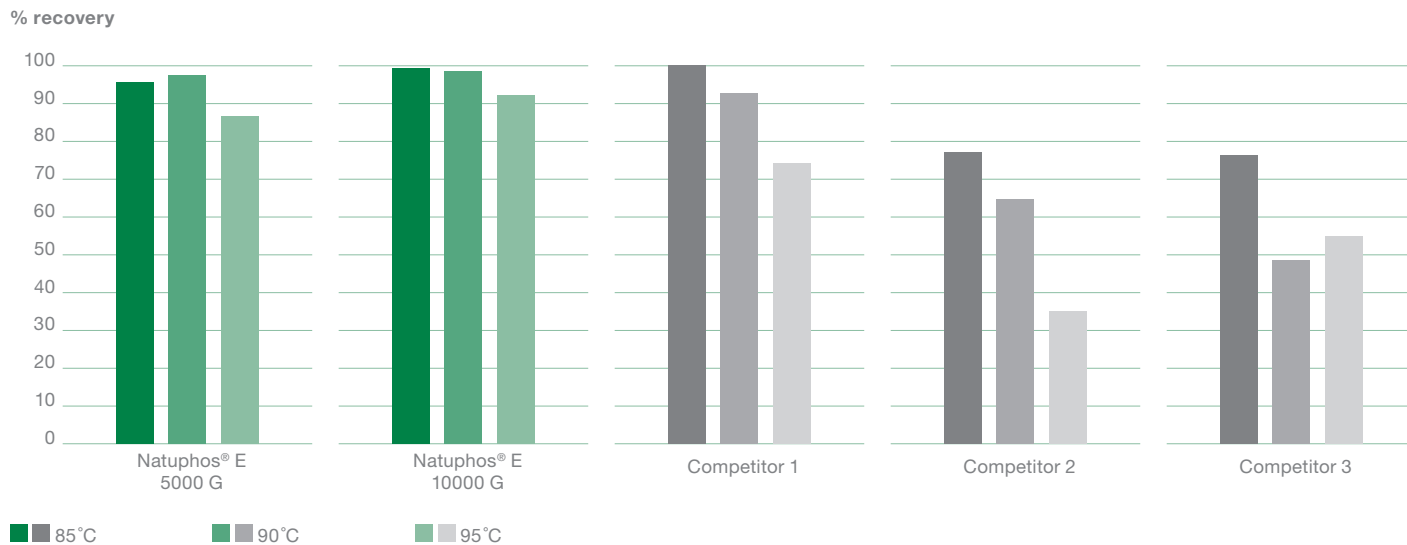
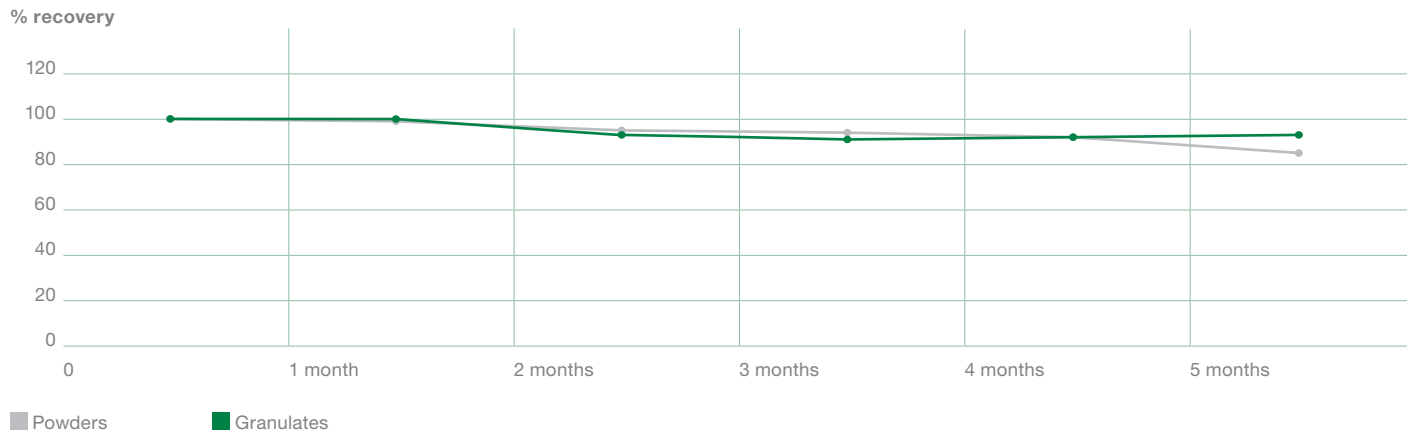


Figure 5: Natuphos® E granulates exhibit an excellent pelleting stability



Conditions: corn/SBM-based broiler diet, 20s conditioning time, die holes: 40 mm x 3 mm, capacity: 600-650 kg/h

Figure 6: Natuphos® E granulates and powders exhibit an excellent stability in broiler premix (storage temperature: 20 °c, n = 3)



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about your specific application
needs.

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 **BASF**

We create chemistry

Natuphos[®] E
Natugrain[®] TS
Natupulse[®] TS



Enzymes to fully utilize the
potential of your feed

- Increasing nutrient and energy digestibility
- Exceptional process and storage stability
- Broad and flexible application
- Improved feed utilization

The science of sustainable feed that succeeds

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