



Knowledge grows

BOLIFOR[®]



Excellence in
Feed Mineral
Quality for optimal
livestock nutrition



BOLIFOR®

Excellence in Feed Mineral Quality for optimal livestock nutrition

Provide livestock with essential macrominerals to sustain healthy and productive growth.

Macrominerals such as phosphorus, calcium or magnesium are essential elements for sustaining healthy and productive animal growth. Yara BOLIFOR feed minerals support bone and muscle formation in monogastric animals (pigs, poultry, horses, and aquatic species) as well as ruminants (dairy and beef cattle, sheep and goats).





BOLIFOR feed minerals – from mine to market

The journey of Yara feed minerals, particularly our inorganic feed phosphates, begins with the phosphorus-rich mineral, apatite, sourced directly from our own volcanic deposit in Siilinjärvi, Finland. As the only European feed phosphates producer with its own mine, Yara extracts high-quality apatite and converts it on-site into phosphoric acid, the essential raw material for manufacturing phosphorus in feed minerals.

Yara's complete control over the entire production process and the exceptional purity of this exclusive deposit enable us to produce high-purity products with naturally low levels of undesirable substances, such as cadmium. Our phosphate from the Siilinjärvi mine exceeds EU standards for purity, ensuring superior quality in every batch.

Our BOLIFOR branded feed minerals are designed to meet the criteria of superior quality, excellent nutritional value, high digestibility and traceability. In a world of generic commodities, Yara's BOLIFOR brand means quality products. BOLIFOR is Yara's Premium Offering for Animal Nutrition. Yara's BOLIFOR brand for feed phosphates has been on the market for nearly 60 years.



Excellence in Feed
Mineral Quality for
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Pure Quality from Source to Feed: The Yara BOLIFOR Difference

Yara's BOLIFOR feed minerals are crafted under precise conditions by reacting high-purity phosphoric acid with calcium, magnesium, or ammonia sources, tailored to the desired product. As the only European feed phosphate producer with direct access to an owned mine of volcanic origin in Siilinjärvi, Finland, Yara stands apart with complete control over the entire production process.

Our fully integrated operation, from mining to manufacturing, allows us to maintain the highest quality standards, ensuring consistent and reliable products. The selected raw materials, all of mineral origin, and our stringent production processes according to GMP+ standards result in feed phosphates with excellent phosphorus digestibility and impurity levels well below EU feed legislation requirements.

Choose from our BOLIFOR product range to deliver superior quality and purity to your feed formulations, backed by our commitment to excellence and trusted sourcing from our exclusive European mine.





The range of Yara BOLIFOR feed minerals

BOLIFOR MCP-F and BOLIFOR MCP-N

Monocalcium phosphate - feed grade

BOLIFOR MCP is a feed grade monocalcium phosphate recommended for use in concentrates, compound feed, mineral feed and other feeds for cattle, pigs, poultry, and all animals also including pet food. BOLIFOR MCP is produced in two different granulations: coarse granulation - MCP-N and standard granulation - MCP-F.

Containing 22.7% total phosphorus, BOLIFOR MCP has been proven to have superior digestibility compared to other monocalcium feed phosphates and typical livestock feed phosphates. This results in a higher digestible phosphorus content, maximizing phosphorus absorption and retention by the animal at lower inclusion levels. Trial details and digestibility data can be provided upon request.

Due to its superior nutritional value, BOLIFOR MCP requires lower inclusion rates than other marketed feed phosphates, this:

- Maximises feed cost-efficiency.
- Minimises logistics, handling, and storage costs.

The purity of the raw materials used to manufacture BOLIFOR MCP ensures:

- Consistency, which guarantees compliance with feed safety requirements worldwide.
- Enables a precise least-cost diet formulation.

BOLIFOR MGP and BOLIFOR MGP+

Magnesium phosphate - feed grade

BOLIFOR MGP is an excellent source of magnesium and phosphorus in concentrates, compound feed, mineral supplements, and other mineral feed applications to prevent magnesium and phosphorus deficiencies in mainly cattle. BOLIFOR MGP+ has 2 % sulfur included in the formula, which is an easily accessible sulfur source for ruminants. Adequate sulfur intake supports efficient microbial protein synthesis in the rumen, enhancing overall feed utilization and productivity.

Bolifor MAP

Mono-ammonium phosphate - feed grade

BOLIFOR MAP is a feed-grade mono-ammonium phosphate, ideal for providing phosphorus to aquatic species. It can also be used in ruminant diets as phosphorous and protein

BOLIFOR MAP is free-flowing and blends easily with other feed material. BOLIFOR MAP has proven high in vitro phosphorus solubility in acidic and neutral conditions. Phosphorus digestibility of BOLIFOR MAP has been assessed, in vivo, in different aquatic species, with out-standing results. Due to its high phosphorus digestibility, BOLIFOR MAP:

- Maximises phosphorus absorption and retention.
- Minimises phosphorus discharge into the water, minimizing the risk of water eutrophication. Preservation of water quality means ensuring aquaculture sustainability.
- BOLIFOR MAP requires lower inclusion rates than other inorganic feed phosphates, maximizing feed cost-efficiency and minimizing logistical handling.



Trials with Yara BOLIFOR feed minerals

Enhanced Broiler Performance and Health with BOLIFOR MCP: A Comparative Study with DCP

Inorganic feed phosphates are used in broiler feed formulation to cover phosphorus requirements. However, similarly to other nutrients, phosphorus is not fully absorbed and utilized by the animal in any feedstuff, including inorganic feed phosphates. The choice of the most absorbable (or digestible phosphorus) feed phosphate source is therefore crucial to maximize farmer's profitability, improve animal health and minimize phosphorus excretion to the environment.

A study by the University of West Virginia tested the effect of different inorganic feed phosphates on early broiler performance and tibia mineralization. Broilers fed BOLIFOR MCP had better performances and more enhanced bone condition than broilers fed dicalcium phosphate (DCP) when diets were formulated to have similar non-phytic phosphorus content. The higher content of absorbable phosphorus of BOLIFOR MCP in comparison with DCP explains this difference.

Another comparison based on a similar absorbable or digestible phosphorus content in diets containing BOLIFOR MCP or DCP was performed. For this purpose, DCP diets required a 40% greater inclusion than the BOLIFOR MCP diet. Similar results for broiler performance and bone condition were obtained for broilers fed either BOLIFOR MCP or DCP when both diets were formulated on a digestible phosphorus basis.

These results highlight

- the advantage of precise knowledge of phosphorus absorbability of the product and
- the advantage of using Bolifor MCP as a feed phosphate source: it is more efficient compared to DCP, as it requires a smaller quantity to meet the same phosphorus requirements in animal feed. This results in a more cost-effective and environmentally sustainable solution for phosphate supplementation.

In other words, less feed phosphate is needed when it is added in form of Bolifor MCP compared with DCP.

DCP
 nPP = 0.22%
 Ca:P = 1.4:1
 Dose*: 0.50%

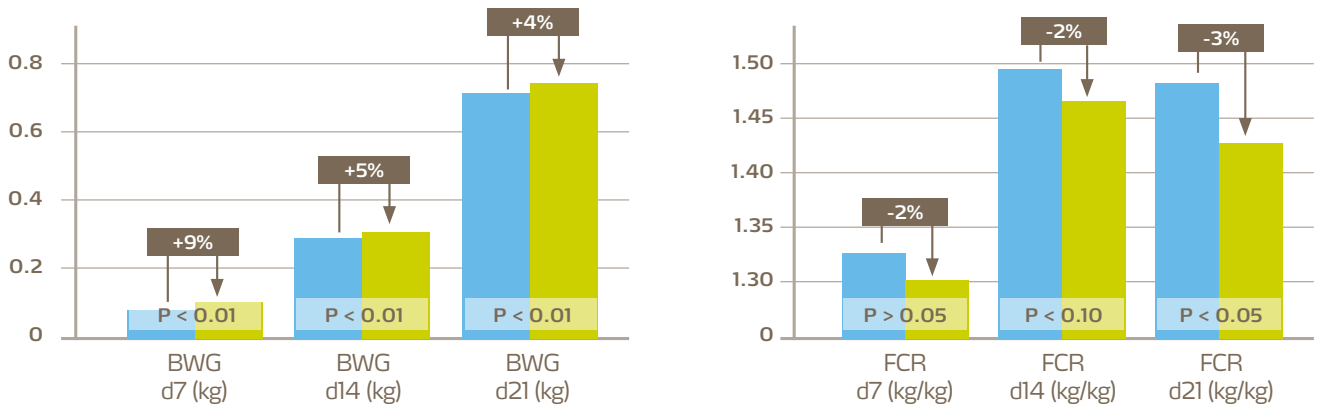
BOLIFOR MCP
 nPP = 0.22%
 Ca:P = 1.4:1
 Dose*: 0.40%

dMCP†
 nPP = 0.20%
 Ca:P = 1.4:1
 Dose*: 0.30%

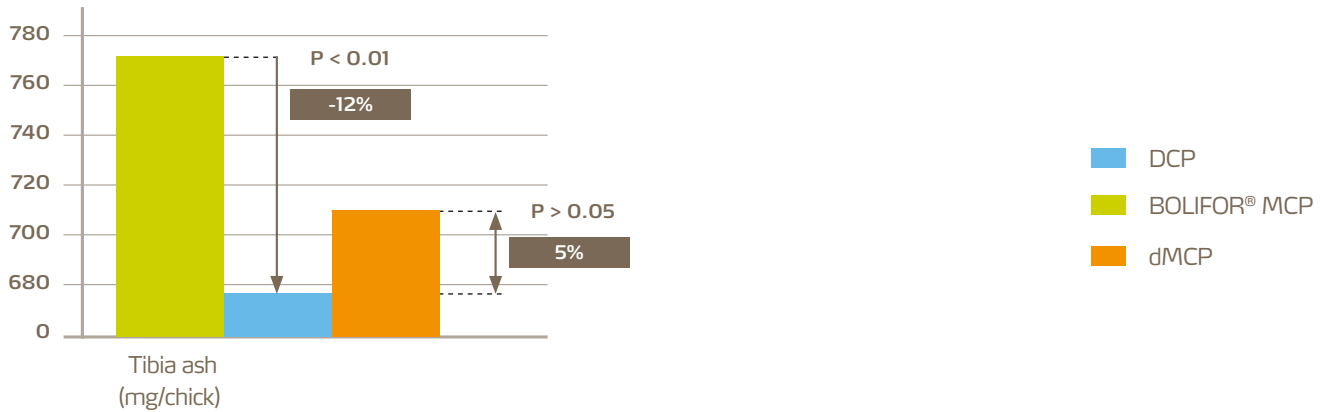
DCP: Dicalcium phosphate, MCP: BOLIFOR® Monocalcium phosphate
 † Digestible MCP (BOLIFOR® Monocalcium phosphate). * Inclusion level of the feed phosphate.

Contrast 1: MCP vs DCP: Similar dietary nPP
Contrast 2: DCP vs dMCP: Similar pre-caecal digestible phosphorus

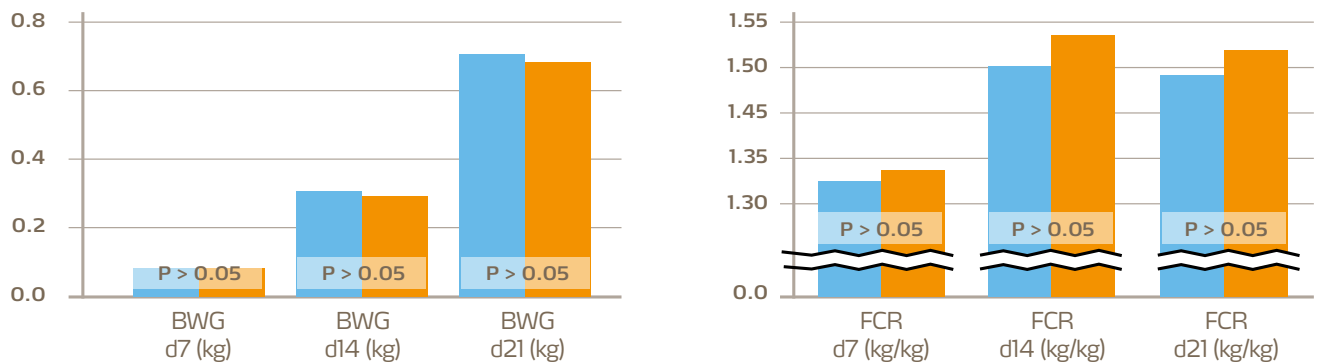
Contrast 1: Similar nPP, DCP vs BOLIFOR® MCP, within each, d7, d14 and d21



Tibia mineralization at d21 for DCP, BOLIFOR® MCP and dMCP



Contrast 2: Similar calculated dietary digestible phosphorus, DCP vs dMCP, within each, d7, d14 and d21.





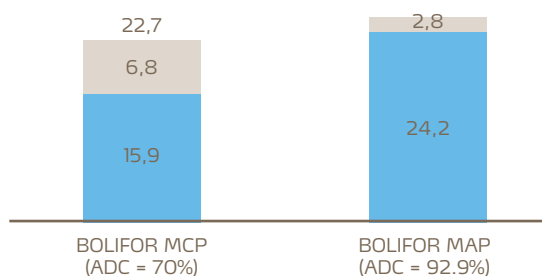
Enhanced apparent phosphorus digestibility of BOLIFOR MAP in aquaculture

Similarly to terrestrial species, phosphorus is a key nutrient in many biological functions such as energy metabolism in aquatic species. The replacement of fish meal by vegetal proteins, poor in digestible phosphorus, increases the demand for inorganic feed phosphates inclusion in aqua feed. However, P is not equally absorbed and utilized by the animal in all feed

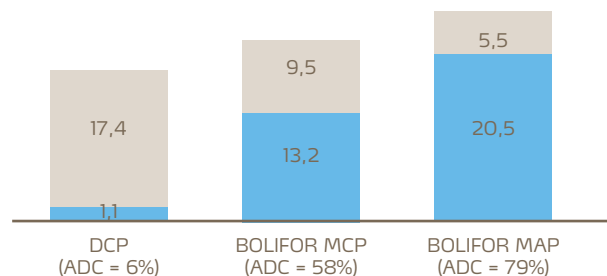
phosphates. The non-digestible phosphorus is excreted as fecal material, which stimulates water eutrophication. Long-term sustainability and business profitability largely rely on precise knowledge of P-digestibility and retention of P sources in each aquatic species.

Yara conducted a series of experiments to assess phosphorous digestibility of different feed phosphates in aquatic species, including Atlantic salmon (*Salmo salar*), rainbow trout (*Oncorhynchus mykiss*) Nile tilapia (*Oreochromis niloticus*) and whiteleg shrimp (*Litopenaeus vannamei*).

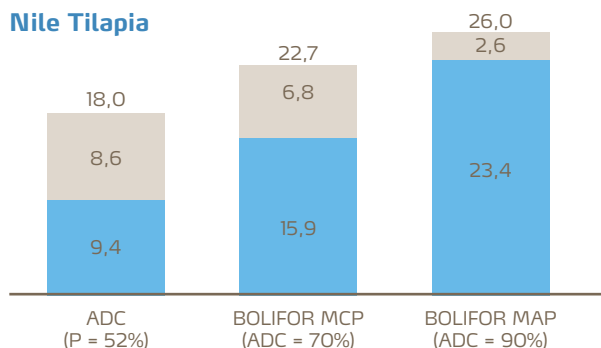
Rainbow Trout



Salmon



Nile Tilapia



Shrimp

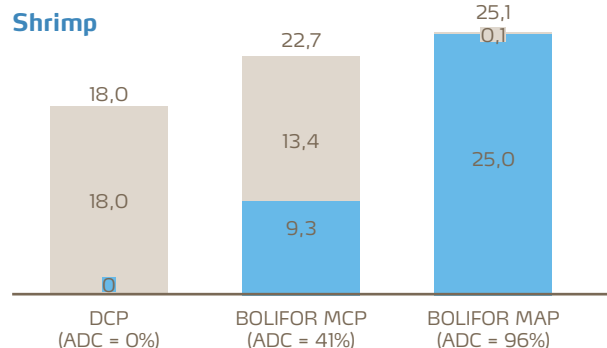


Figure 1: Apparent digestible and non-digestible P content (% of the product) of BOLIFOR MCP and BOLIFOR MAP in rainbow trout, salmon, shrimp and Nile tilapia. Apparent digestibility coefficients (ADC) of phosphorus are displayed on the X-axis. Apparent digestible P = total content of P in the phosphate x ADC. Based on Morales et al. 2018 and unpublished results.

■ Non-digestible P content (%)
 ■ Digestible P content (%)

BOLIFOR MAP and BOLIFOR MCP exhibit outstanding phosphorus digestibility across various species, including rainbow trout (70 and 93% for BOLIFOR MCP and MAP, respectively) (Figure 1); Salmon (58 and 79% for BOLIFOR MCP and MAP, respectively); Nile tilapia (70 and 90% for BOLIFOR MCP and MAP, respectively) and shrimp (96% for BOLIFOR MAP)

Surprisingly, DCP turned out to be very undigestible in shrimps and salmon and poor in Nile tilapia (0% in shrimps and 6% in salmon. Not tested in rainbow trout) despite diets were formulated to be below requirements with regards to P. This suggests DCP is very inappropriate for these species.

The scientific results support the use of BOLIFOR MAP in aqua feed least-cost formulations, independent of calcium content in the diet.

These conclusions highlight the significant advantages of using BOLIFOR MAP in aquaculture feed to enhance performance, profitability, and environmental sustainability.

Further details are available upon request.





Pellet durability increase with BOLIFOR MCP

Diets with high levels of fat and fibre content, such as the ones based on corn distillers dried grains and solubles (ethanol co-products) are notoriously difficult to pellet. The addition of inorganic feed phosphates improves the feed manufacture and pellet quality of these diets. A study by the University of West Virginia investigates the effect of different inorganic feed phosphates on feed manufacture and pellet quality.

Pellet durability increased when Yara BOLIFOR MCP was included (New Holmen Pellet Tester), in comparison

with diets containing mono dicalcium phosphate (MDCP) or defluorinated phosphate (DFP) (88.18 vs. 84.63, 83.02 %, respectively). Manufacturing diets containing BOLIFOR MCP maintained similar amperage relative to diets containing DCP or MDCP and did not influence production costs. This study reveals the importance of the inorganic feed phosphate source for pellet manufacturing and pellet quality.

Further details are available upon request.

Peace of mind comes from accreditation.



Yara Animal Nutrition is an active member of the European Chemical Industry Council (CEFIC), Sector Group for Inorganic Feed Phosphates. CEFIC represents European feed producers, supporting a system guaranteeing the chemical and physical composition and the pureness of the feed products.

Why Yara BOLIFOR Feed Minerals? Trusted Quality, Proven Performance.



Choosing Yara BOLIFOR feed minerals mean selecting high-purity products that are naturally low in undesirable substances, ensuring superior performance and value. Here's why Yara BOLIFOR stands out:

- **Quality and Purity from the Source:** Our feed phosphates originate from our own clean volcanic deposit in Siilinjärvi, Finland. Owning this exclusive mine allows us to control the quality from the very start, ensuring consistently high purity that meets and exceeds EU standards.
- **Integrated Production and Logistics:** With our mine in Siilinjärvi and a state-of-the-art production plant in Kokkola, Finland, we maintain full control over the entire manufacturing process. Additionally, our logistics terminal in the Netherlands ensures efficient and reliable delivery across Europe, optimizing the supply chain for our customers.
- **Consistency You Can Trust:** By sourcing phosphorus exclusively from our high-quality deposit and controlling every step of production, we guarantee consistent feed phosphate quality, batch after batch.
- **Reliable Supply:** Our 24/7 production operations ensure a steady and dependable supply, minimizing disruptions and meeting the needs of animal producers worldwide.

- **Superior Digestibility and Feed Efficiency:** Our inorganic feed phosphates have proven to deliver exceptional digestibility across various trials and species. This enhances nutrient absorption, leading to maximum returns on feed investment and a lower over-all cost per unit of nutrition.
- **Environmental Benefits:** High digestibility means less phosphorus waste, helping farmers meet environmental regulations while providing optimal nutrition for their live-stock.
- **Enhanced Palatability:** A more palatable product encourages higher consumption by animals, reducing nutrient waste and enhancing feed performance.
- **Commitment to Quality Standards:** As a member of the CEFIC IFP group, we adhere to the highest industry standards, further ensuring the quality and safety of our feed phosphates.

Choose Yara BOLIFOR feed minerals for unmatched quality, consistency, and supply reliability, backed by our unique, integrated European production and logistics network and commitment to industry-leading standards.

About Yara

Yara grows knowledge to responsibly feed the world and protect the planet. Supporting our vision of a world without hunger and a planet respected, we pursue a strategy of sustainable value growth, promoting climate-friendly crop nutrition and zero-emission energy solutions. Yara's ambition is focused on growing a nature positive food future that creates value for our customers, shareholders and society at large and delivers a more sustainable food value chain.

To achieve our ambition, we have taken the lead in developing digital farming tools for precision farming and work closely with partners throughout the food value chain to improve the efficiency and sustainability of food production. Through our focus on clean ammonia production, we aim to enable the hydrogen economy, driving a green transition of shipping, fertilizer production and other energy intensive industries.

Founded in 1905 to solve the emerging famine in Europe, Yara has established a unique position as the industry's only global crop nutrition company. We operate an integrated business model with around 17,500 employees and operations in 60 countries, with a proven track record of strong returns. In 2022, Yara reported revenues of USD 24.1 billion.

www.yara.com



Interested in Yara's animal
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