

# Achieving 100% inorganic phosphate-free broiler diets from day one

Driving the science towards sustainable broiler production



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The poultry sector has made many improvements over the years to reduce its environmental impact. However, some issues remain, including the need to supplement feeds with inorganic phosphorus, an unsustainable resource with a negative environmental impact. For instance, producing one tonne monocalcium phosphate (MCP) corresponds to ~750 kg of emitted CO<sub>2</sub> [1].

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### Inorganic phosphorus: an old issue that resonates today

Phosphorus is an essential dietary nutrient for broilers. It supports healthy growth, bone development, and proper nerve function particularly early on during chick-rearing, but also aids energy conversion as well as egg production [2, 3]. To avoid phosphorus deficiencies, feed is normally formulated with safety margins [4], which translates into higher feed costs and reduced profitability. In addition, this causes excess phosphorus to be excreted in the form of manure, seeping into soil and groundwater with negative environmental consequences [5].

As the global awareness of environmental footprint grows, producers must modify and improve feed formulations to meet nutritional requirements and simultaneously reduce the environmental impact of farm operations.

### Phytase: an on-going (r)evolution

In all-vegetable broiler feeds, which are increasingly common globally, most phosphorus is present as phytate, a largely unavailable form of this nutrient. Thus, to meet phosphorus requirements, nutritionists need to add inorganic phosphorus and phytase to feed formulas. Phytase is beneficial as this enzyme breaks down phytate and makes phytate-phosphorus available to the animal. Phytase addition reduces the need for inorganic phosphate supplementation [6, 7]. Yet, until today, phosphate supplementation could not be fully eliminated from commercial feed formulations in broilers, especially during the starter phase (1-10 days of age).

The starter phase poses the biggest challenge for the total removal of inorganic phosphorus from broiler feeds. The recommended digestible phosphorus requirement for broiler feed varies from 0.42% to 0.45%. Depending on the diet formulation, the digestible phosphorus contribution from ingredients, such as cereals, is between 0.12% and 0.15%. This means that more than 0.25% of the digestible phosphorus needs to be delivered by phytase activity. However, 0.25% is significantly higher than the matrix value of any commercial phytase currently available in the market for dose levels between 500 and 1500 FTU/kg.

**For the first time, the total replacement of inorganic phosphate from day one in broilers fed all vegetable diets has been shown to be a viable possibility: Axtra® PHY GOLD has the potential to nullify the need for inorganic phosphorus additives.**

# Our novel approach

We carried out a project at Texas A&M University to determine whether inorganic phosphorus-free (IPF) vegetable broiler diets are possible with a highly efficient phytase supplementation while maintaining growth performance and bone development throughout all development phases (Figure 1).

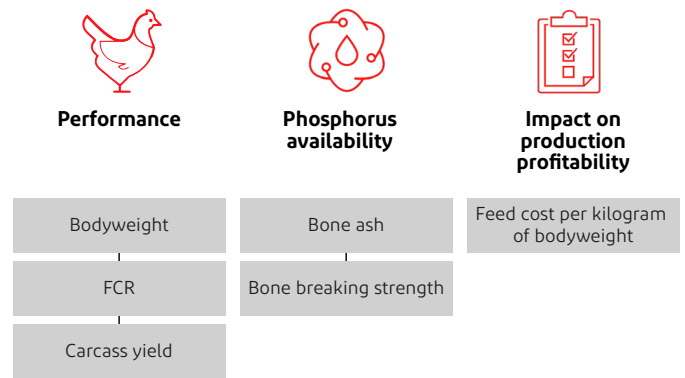


Figure 1 – Performance, phosphorus availability and profitability indicators assessed during the project.

Within the project two separate trials were conducted to assess the efficacy of Aextra® PHY GOLD in high phytate diets (>0.33%) with all iP removed and a Ca matrix applied, with and without phase specific dosing and in combination with Danisco® Xylanase (Table 1).

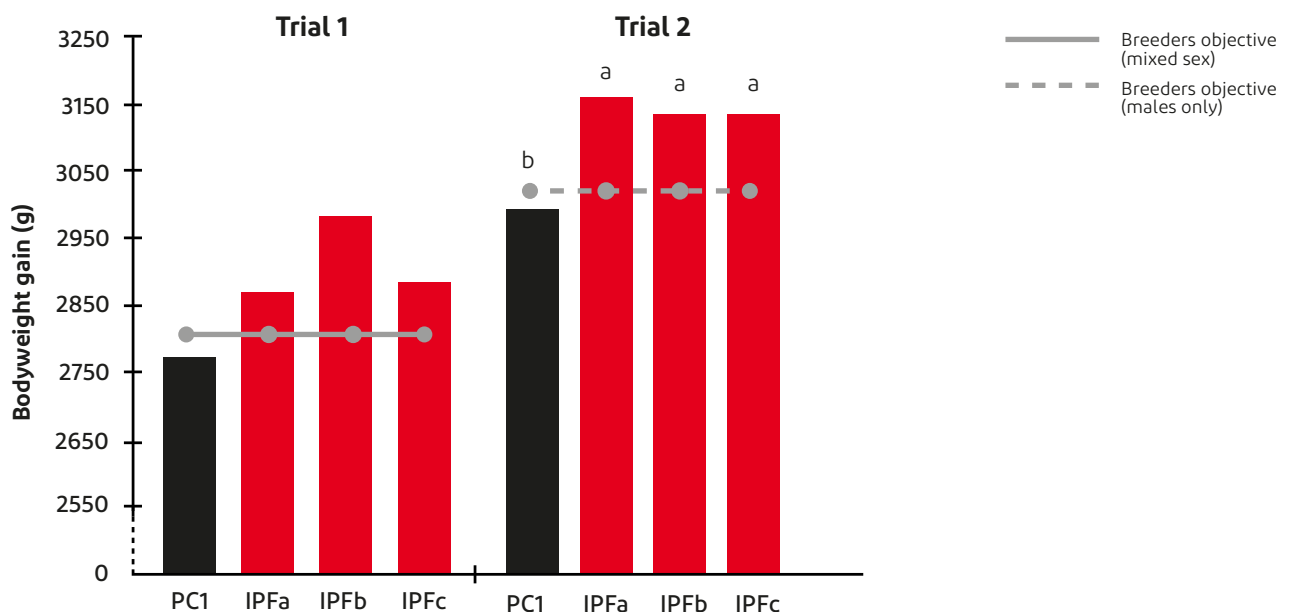
Treatment	Aextra®PHY GOLD, FTU/kg				Danisco®Xylanase, XU/kg	MCP	Matrix
Age	1-10d	11-21d	22-35d	36-42d	1-42d	1-42d	All phases
PC	None				None	Yes	None
IPFa	1000	1000	1000	1000	None	None	Ca
IPFb	3000	2000	1000	1000	None	None	Ca
IPFc	2000	1500	1000	1000	2000	None	Ca, ME

Table 1 – Experimental design of the inorganic phosphor free (IPF) study.

## Maintaining performance goals

Supplementation at 1000 FTU/kg, compared to the positive control, resulted in improved or equal growth performance and feed efficiency in diets containing no iP and reduced in calcium according to the product matrix recommendations (IPFa). These results demonstrate that Aextra® PHY GOLD can fully replace inorganic phosphorus supplementation in broiler diets.

Aextra® PHY GOLD in combination with Danisco® Xylanase (IPFc) with additional energy reduction showed statistically similar results of final bodyweight and FCR to higher doses of Aextra® PHY GOLD on its own (IPFb) (Figure 2). The phase dosing strategy of 3000, 2000 and 1000 FTU/kg in starter, grower and finisher phases respectively (IPFb), further improved bodyweight and FCR vs PC.



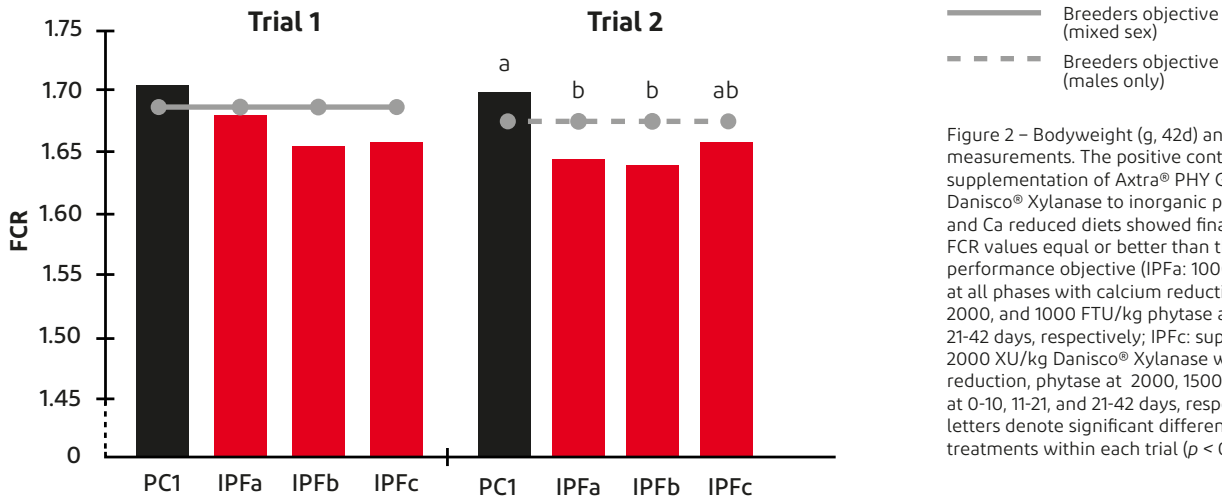


Figure 2 – Bodyweight (g, 42d) and FCR (0-42d) measurements. The positive control and the supplementation of Aextra® PHY GOLD w/o Danisco® Xylanase to inorganic phosphorus-free and Ca reduced diets showed final bodyweight and FCR values equal or better than the breeders' performance objective (IPFa: 1000 FTU/kg phytase at all phases with calcium reduction only; IPFb: 3000, 2000, and 1000 FTU/kg phytase at 0-10, 11-21, and 21-42 days, respectively; IPFc: supplemented with 2000 XU/kg Danisco® Xylanase with 71 kcal/kg ME reduction, phytase at 2000, 1500, and 1000 FTU/kg at 0-10, 11-21, and 21-42 days, respectively). Different letters denote significant differences between treatments within each trial ( $p < 0.05$ ).

Bone ash and breaking strength are key indicators of the ability of a phytase to make phosphorus available to broilers. Aside from outperforming its direct competitors (data available upon request), Aextra® PHY GOLD's superior bioefficacy was also validated in these experiments during the starter phase of broiler development.

For instance, bone-breaking strength of broilers fed with the inorganic phosphorus-free diet supplemented with the highest starter phytase dose (3000 FTU, IPFb) or 2000 FTU phytase + Danisco® Xylanase (IPFc) significantly surpassed the results of the positive control in the first study and was equivalent in the second study (Figure 3).

These results demonstrate that Aextra® PHY GOLD can successfully replace all inorganic phosphorus supplementation while maintaining bone mineralization.

This is crucial as a negative impact on bone mineralization would pose a welfare issue, causing lameness in the flock and has been a key barrier to attempting IPF diets.

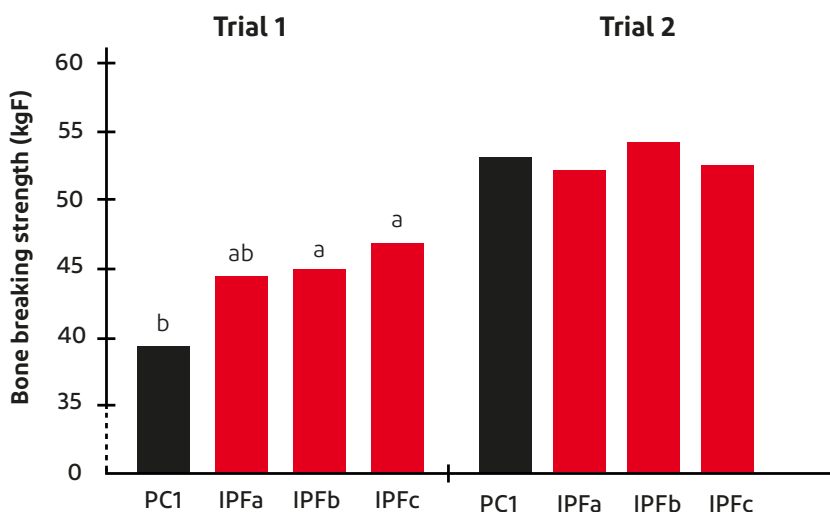


Figure 3 – Broiler's bone strength measured at 42 days of age. Different letters denote significant differences between treatments within each trial ( $p < 0.05$ ).

## Improving formulation flexibility and profitability

Diets used in the trial were high phytate ( $\geq 0.33\%$ ) and the data indicated feed costs savings/kg bodyweight of between 3.5% and 4.5% in the diets where all inorganic P was removed.

We can also see when comparing IPFc to IPFb that combining phytase and xylanase allows us to apply higher down specs and maintain performance with lower doses of phytase (Figure 4, across two trials). All IPF treatments reduced feed cost per kg BWG and demonstrated improved profitability with the greatest economic returns shown with a phased dosing strategy.

In addition to demonstrating that full removal of inorganic P is possible, these trials show the possibility of moving to higher phytate levels in young chick diets and opens up the ability to relax constraints on addition of phytate rich ingredients into starter diets when using Aextra® PHY GOLD.

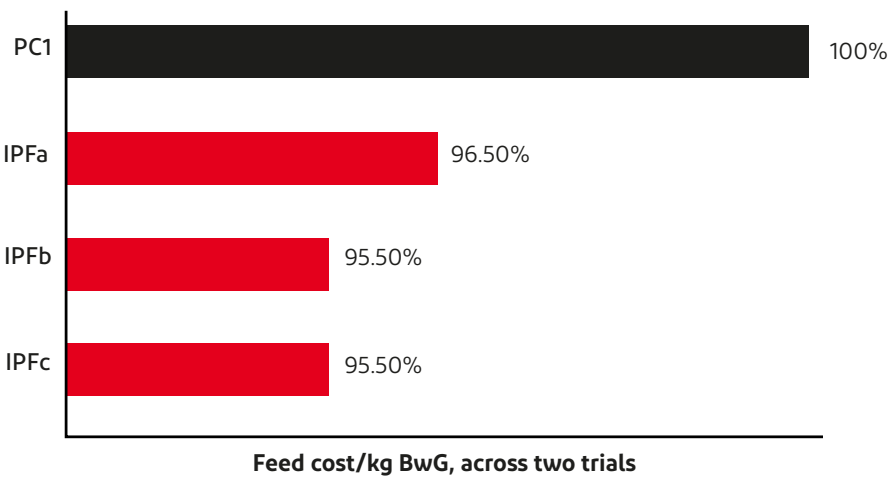


Figure 4 – Feed costs per kg BWG of enzyme-supplemented and phytate-rich diets as relative to the positive control (PC).

## Improving sustainability

To realise inorganic phosphate-free broiler diets, there must be sufficient phytate phosphorus in the diet to deliver the P to meet requirements of the birds. Although 1000 FTU/kg Aextra® PHY GOLD was sufficient to liberate the required phosphorus and maintain performance in this research setting with high levels of phytate, higher dosing was beneficial to optimise the extra phosphoric effects and further improve performance.

With a proper phytase dosing strategy phytate P level could be reduced to less than 0.33% especially in finisher phases, while maintaining performance in 100% inorganic P-free diets, leading to further reductions in phosphorus excretion. This in combination with the application of amino acid and energy matrix values for the phytase could also reduce nitrogen excretion.

With the current global situation and the uncertainty around imports of raw materials the likelihood is that producers may have to turn to more locally sourced ingredients even if they are of lower quality and move away from the traditional corn/soy or wheat/soy diets. In order to do this nutritionists need to be confident that the increased phytate levels this could introduce into the diet will not cause performance issues.

These preliminary trials demonstrate that the use of a reliable, well researched phytase such as Aextra® PHY GOLD with a tailored dosing strategy can offer producers increased flexibility and confidence when changing diet formulations.

Additional studies in a wider range of diet types and at larger scale are currently on going to validate further the ability to fully remove inorganic P in commercial flocks. Preliminary results are in agreement with the current studies, at lower phytate levels in grower and finisher phases. The incentives to reduce inorganic phosphate inclusion are large as the industry should be able to reduce the usage of monocalcium-phosphate in broiler feeds by at least one million tonnes/ year.

This represents a massive step towards more environmentally sustainable broiler production and a significant decrease in the poultry industry's impact on the pollution of local streams and rivers through runoff.

# A golden future for broiler production

For the first time, the total replacement of inorganic phosphate from day one in broilers fed all vegetable diets has been shown to be a viable possibility: Axtra® PHY GOLD has the potential to nullify the need for inorganic phosphorus additives. This new enzyme allows cost savings from full removal of inorganic P while delivering results within the breeder objectives performance range.

The very real possibility of reducing P safety margins in commercial diet formulation, relaxing constraints on inclusion of phytate rich ingredients and freeing broiler diets from the burden of inorganic phosphate supplementation places Axtra® PHY GOLD at the front of the race towards a more sustainable broiler production.

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