

ENZYMES IN TURKEY FEEDS



**MOVING
POULTRY
NUTRITION
INTO THE 21ST
CENTURY**

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**Innovative
Poultry
Nutrition**

WHAT IS AN ENZYME?

- An enzyme is a protein that functions as a biological “catalyst”: meaning it helps speed up a chemical reaction.
- Enzymes act on “substrates” breaking them down into smaller molecules called “products”.
- Enzymes typically end in “ase”.
- For example: In our mouth is saliva which contains “amylase”. Amylase breaks down carbohydrates (substrate) into sugars (products) for increased absorption.
- Bread is a well known carbohydrate.

OTHER EXAMPLES



Lactose intolerant people lack the enzyme *Lactase*, needed to break down the milk sugar (lactose).



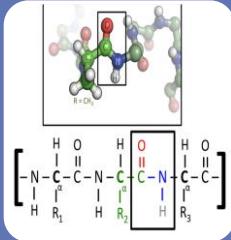
Beano, is a dietary supplement used to reduce gas. The enzyme responsible is *alpha-galactosidase*.

ENZYMES ARE SELECTIVE ON THE SUBSTRATES THEY WORK ON



Carbohydrates

- Amylase



Protein

- Protease



Fat

- Lipase

ENZYMES

A few years back the addition of enzymes in the poultry industry was considered as either

FOO FOO DUST or **SNAKE OIL**

SNAKE OIL

Mainly Because

They came out of other industries.

ENZYMES

- Feed enzymes were taken from these industries:
 - Beer
 - Wine
 - Cheese
 - Oil
 - Pulp
- The Problem:
 - These enzymes were not heat stable. They do not have to go through a pellet mill.
- The Solution:
 - Look for natural heat stable enzymes or use a coating to make them heat stable.

WHAT DO ENZYMES HAVE TO DO WITH FEEDING MY BIRDS?

- Most Turkey Feeds will Contain the Following Ingredients:
 - CORN
 - WHEAT
 - WHEAT MIDDS
 - DDGS
 - SOYBEAN MEAL
 - MEAT MEAL
 - FAT

These ingredients require “enzymes” to allow for the breakdown and utilization of nutrients needed for optimal growth, egg production, etc.

HOWEVER

- Not all of these ingredients are 100% digestible (Ex: protein)
- Most contain “anti-nutritional” factors that impede digestion of other nutrients
 - Phytate
- While others contain complex starches that can lead to increased gut viscosity and wet litter
 - Wheat

INTRODUCTION OF EXOGENOUS ENZYMES INTO POULTRY DIETS

- Exogenous means it does not come from within, like normal metabolic enzymes found in the body, called endogenous, these enzymes have to be provided to the animal in the feed.
- Ex: poultry lack endogenous phytase needed to breakdown phytate

PHYTASE WAS THE “BREAKTHROUGH” ENZYME DUE TO ISSUES IN MARYLAND

- The Maryland Water Quality Improvement ... use a site-specific phosphorus index, based on slope, runoff ... all contract feed for poultry must include phytase

[The Maryland Water Quality Improvement Act of 1998](#)

[*www.sites.ext.vt.edu/newsletter-archive/fmu/1998-10/mdwater.html*](http://www.sites.ext.vt.edu/newsletter-archive/fmu/1998-10/mdwater.html)

PHYT-ASE

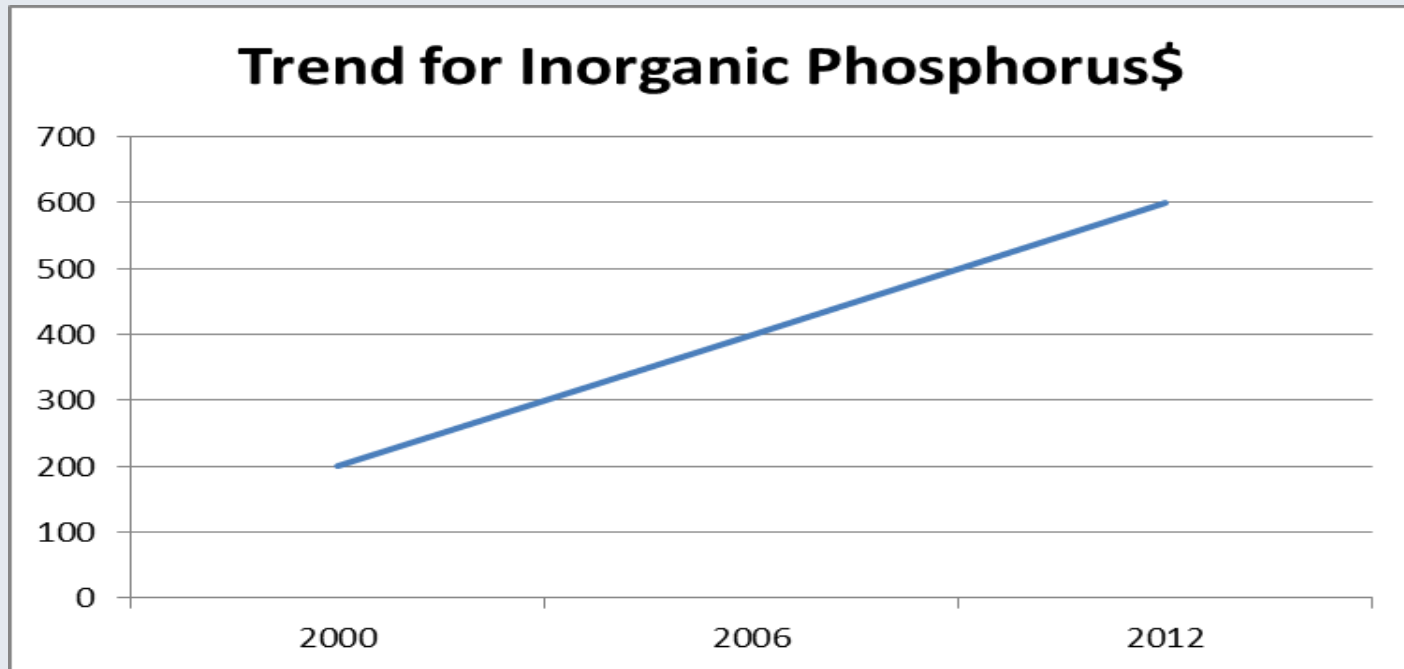
- Is an enzyme that speeds up the breakdown of phytate (anti-nutrient) in feed.
 - Phytate binds inorganic phosphorus, minerals and other key nutrients making them unavailable to the bird which are then “excreted”
 - Phytate when **not** broken down is also an irritant to the gut, resulting in even more endogenous losses to the animal that may lead to poorer performance
- Phytase, when used in the diets of animal, makes the phosphorus available to the animal, allowing for lower usage of inorganic phosphate.

PHYTASE'S INTRODUCTION

- Producers in Maryland were forced to use the only phytase available (BASF)
- Price of phytase was high
- Price of inorganic phosphorus was low

PHYTASE TODAY

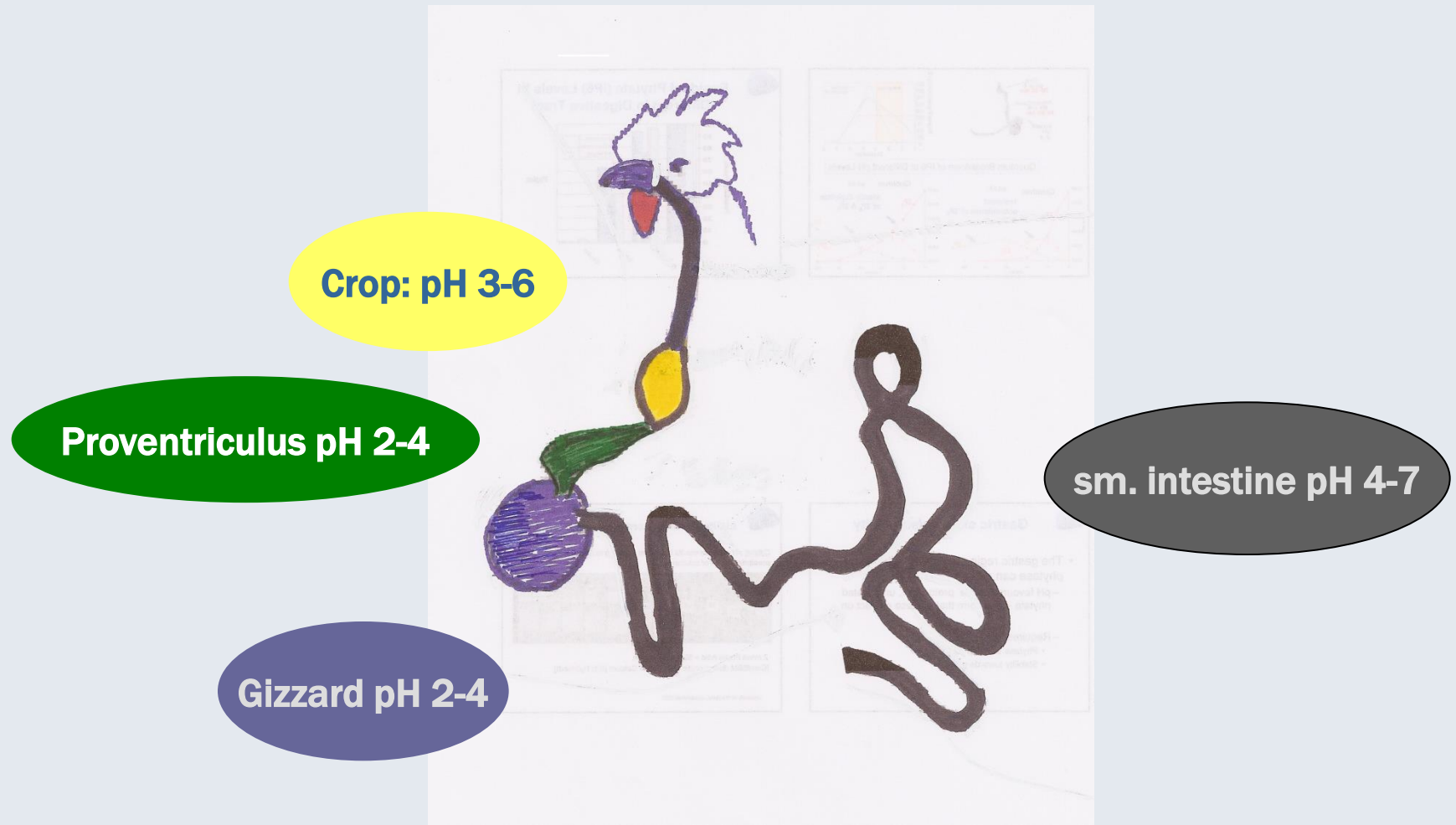
- Cost of phytase has come down
 - Several phytase's on the market today
- Price of inorganic phosphorus went up



PHYTASE ENZYMES HAVE ADVANCED

- Initial phytase; aspergillus, spared 0.10% available phosphorus
- Fungal phytase, coated so more heat stable, spared 0.10% available phosphorus
- E.coli phytase “more advanced”, these spare between 0.12- 0.15% available phosphorus

The phytase enzyme needs to work in the upper part of the GI Tract otherwise once past the gizzard, the enzyme is no longer able to cleave off the P molecule



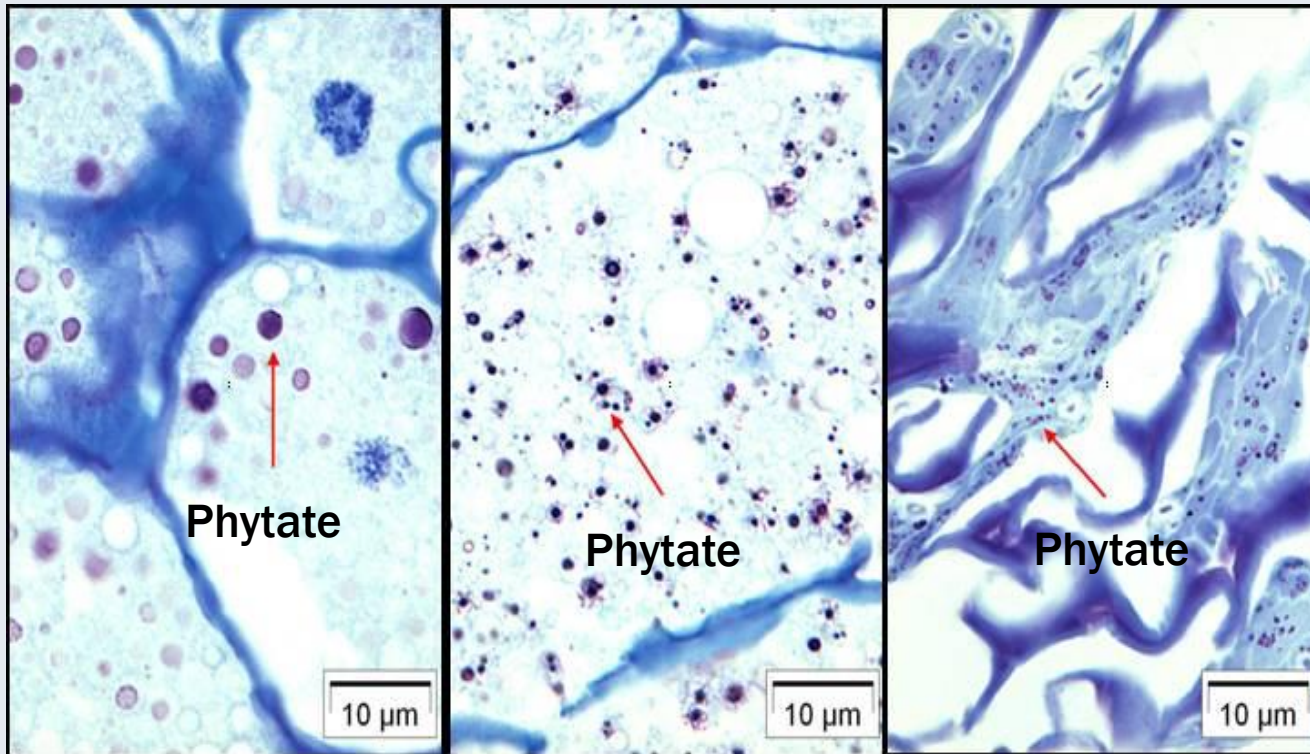
WHAT IS THE SIGNIFICANCE OF SPARING PHYTASE?

| Av P Spared | Cost of Typical Starter Diet |
|-------------|------------------------------|
| No Phytase | \$463.25 |
| Phytase | \$451.25 |
| | |
| | |

Due to the significant cost savings, almost 95+% of all poultry diets contain phytase

HOW THE PHYTASE ENZYME WORKS

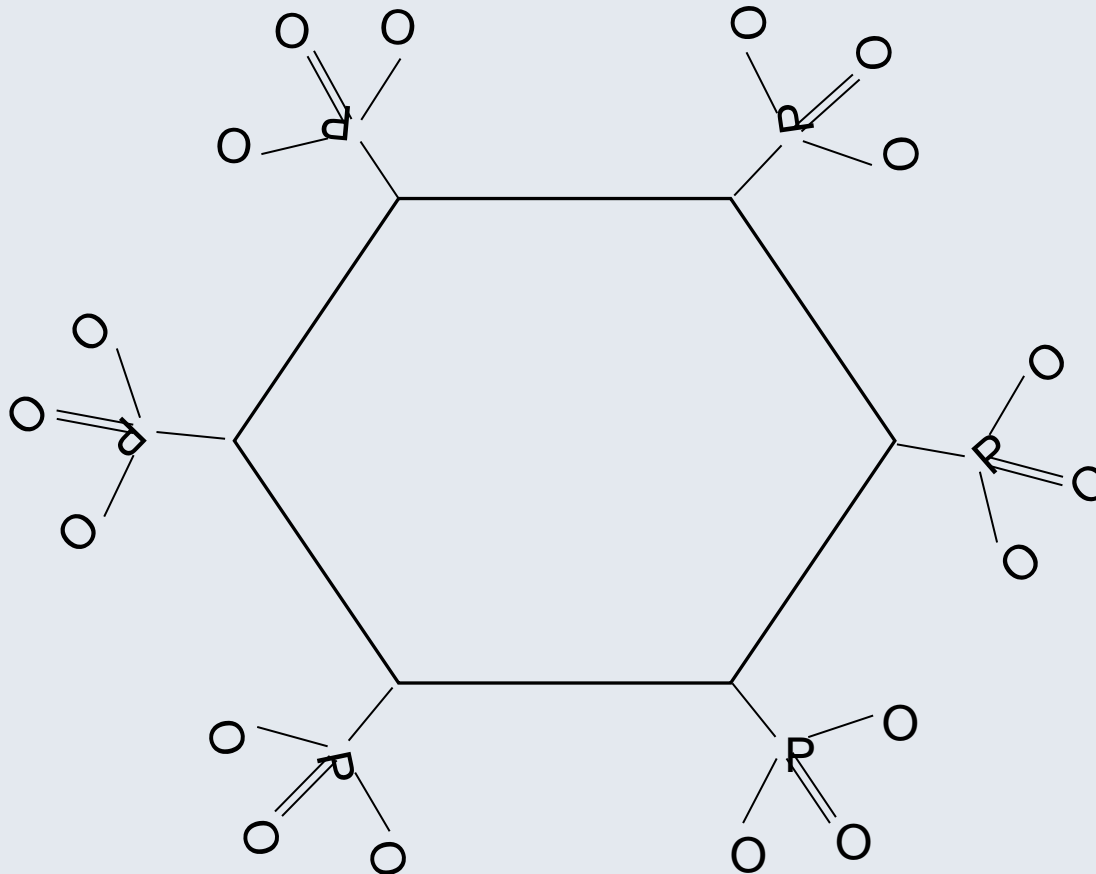
- Breaks down the Phytate



Phytate is found in corn, wheat, DDGS, soybean meal & others

PHYTATE MOLECULE

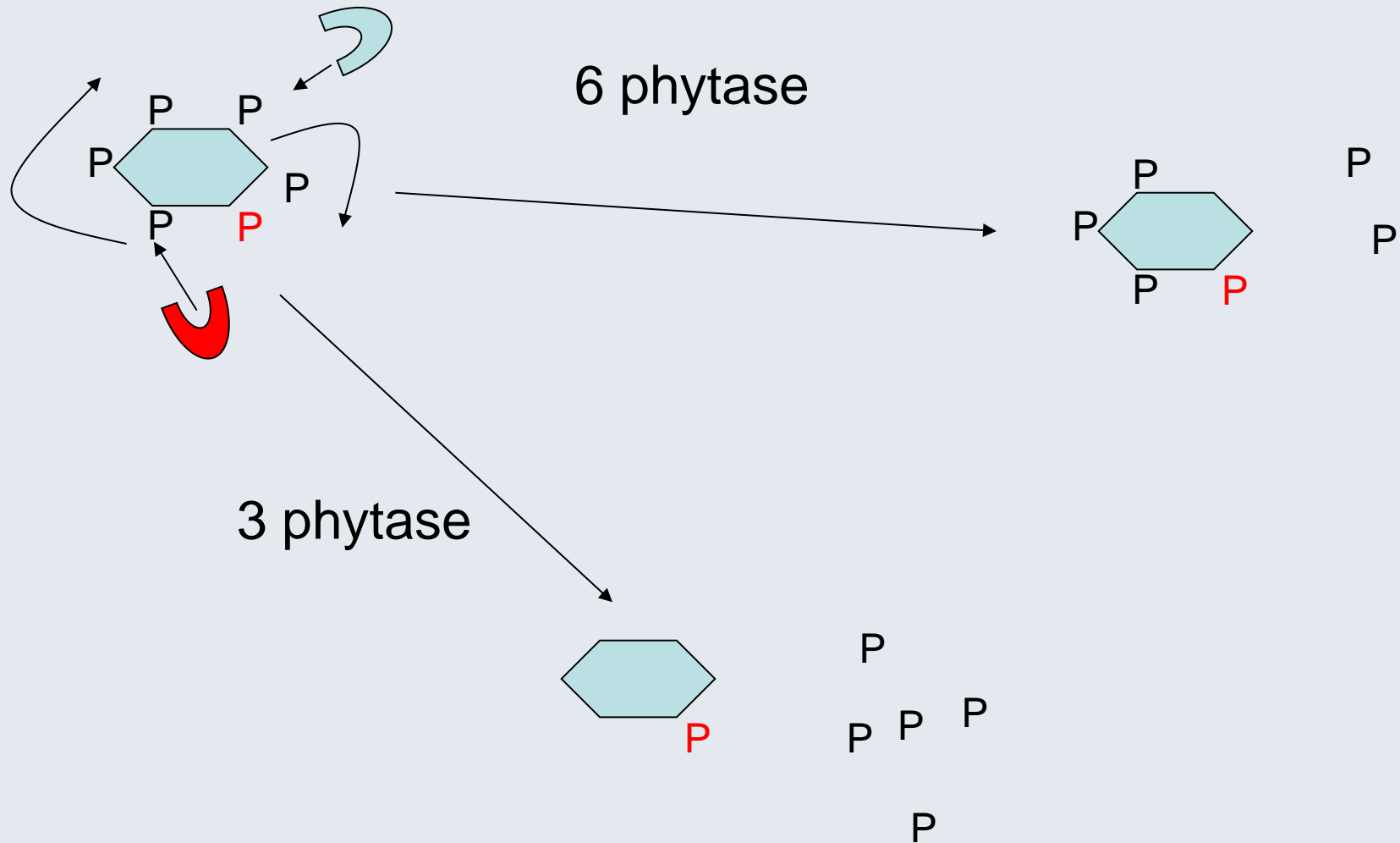
- 6 phosphates on an “Inositol Ring”



PHYTASE

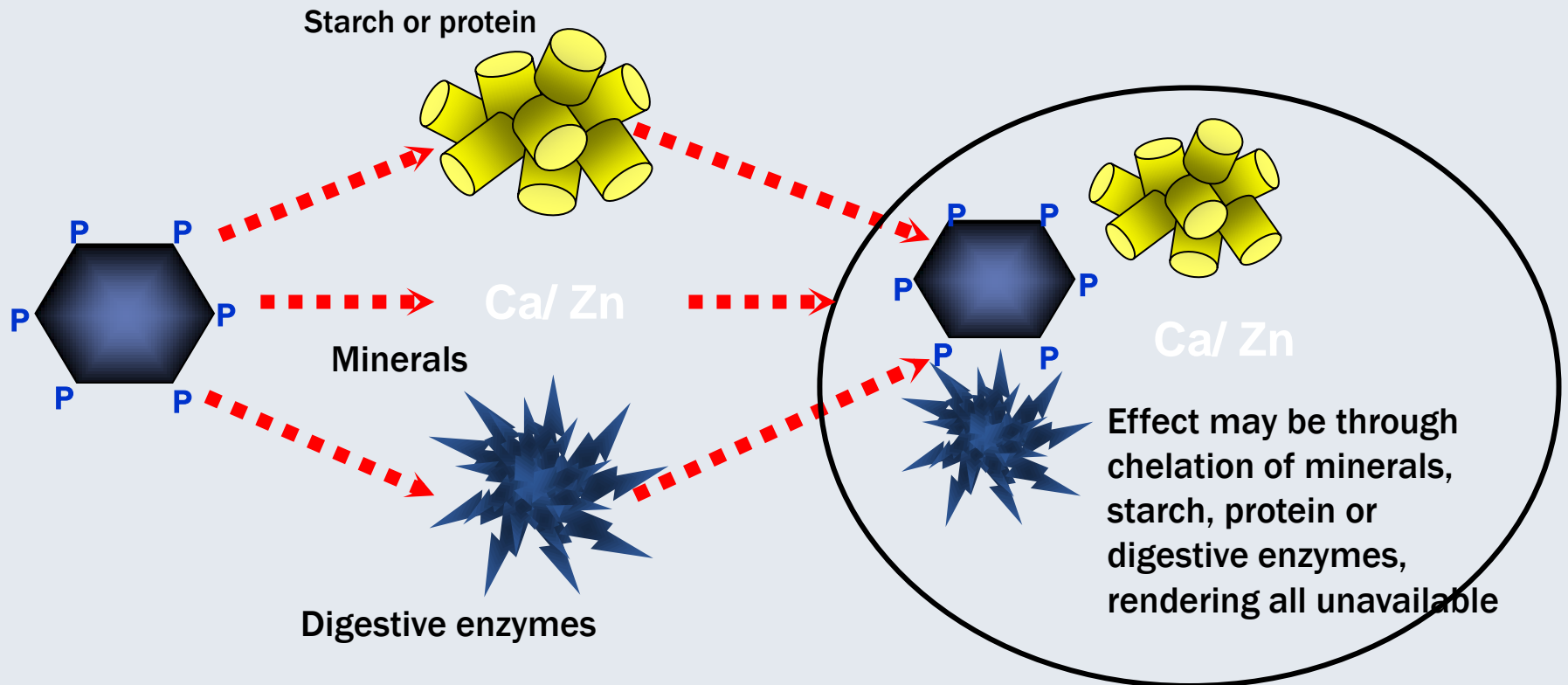
- Fungal phytases remove all but the number 2 phosphorus before going to the next phytate molecule in a slow structured approach.
- E. Coli phytases remove the number 6 and number 1 phosphates and can quickly and randomly move to the remaining phytate molecules.

PHYTASE WORKS BY “CLEAVING” OFF THE PHOSPHORUS GROUPS ON THE INOSITOL RING



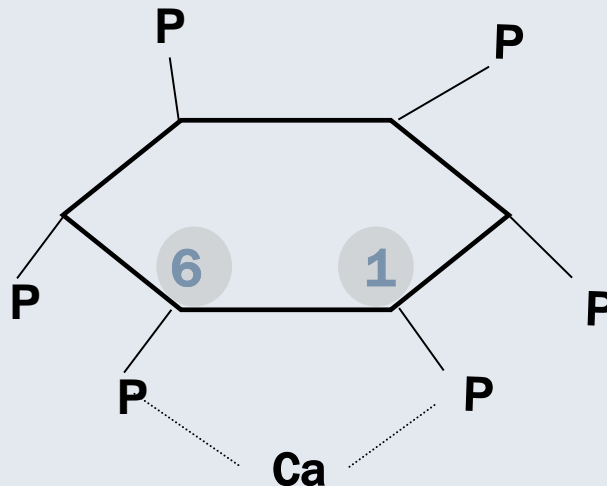
PHYTATE CAN CHELATE WITH KEY NUTRIENTS IN THE GUT

- *Phytate can decrease intestinal digestibility by the formation of insoluble complexes of nutrients and digestive enzymes*



IF A PHYTASE IS NOT PRESENT THEN THE ANTI-NUTRITIONAL ARMS OF PHYTATE CAN BIND KEY NUTRIENTS

- Anti-nutritive “arms” of phytate are electrostatic resulting in reactivity with:
 - Basic AA residues (Arg, Lys, His)
 - Cations (Zn, Mg, Fe, Ca, Na, Mn, Cu)
- These key minerals and nutrients are lost
- Irritation to the gut from phytate, results in an energy loss to the birds.



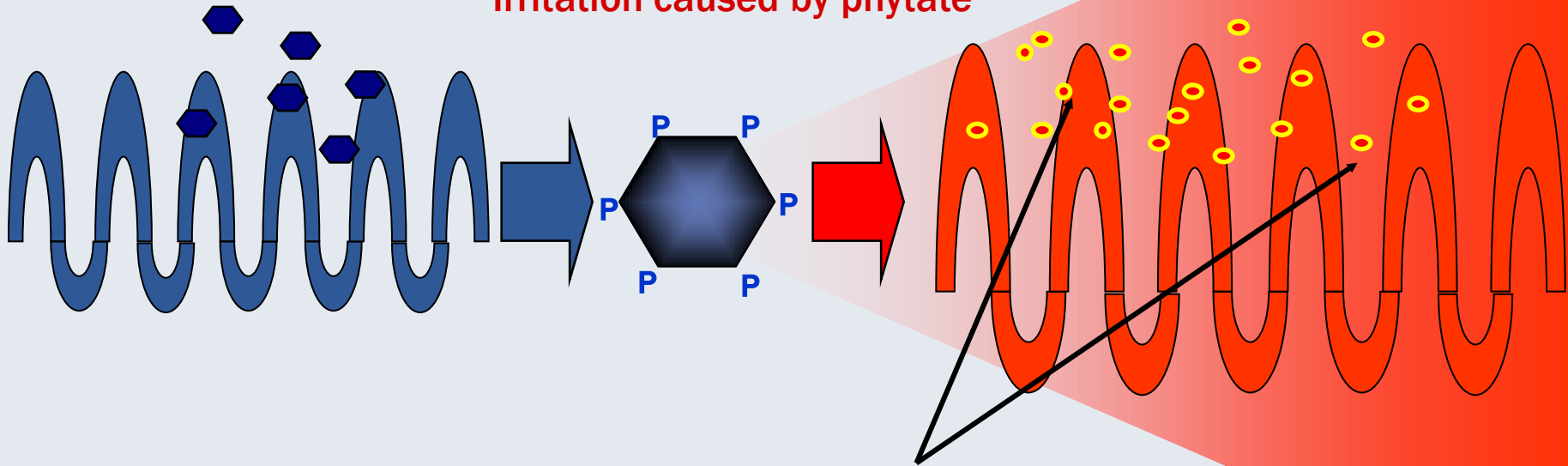
PHYTATE

- The phytate molecule is very Inflammatory in the birds intestinal track.
- It causes extra acid to be produced, thus burning the lining of the gut.

PHYTATE PROBLEM INCREASES MUCOUS SECRETION

Irritation in animal gut leads to loss of efficiency

Irritation caused by phytate



Phytate can cause:

- Increase in sloughed cells and changes in villa
- Potential immune reaction - negative
- Increase mucous secretion leads to greater endogenous losses

HOW DO BIRDS HANDLE INFLAMMATION

- **Birds Produce Mucin To Coat The Inflammation:**
 - Mucin is a protein that is produced in the gut wall
 - Mucin is then transported to the gut lumen using sodium and energy to carry it through the gut wall.
 - This increases gut maintenance

HOW THE BIRD HANDLES INFLAMMATION

- Amino acids (protein) are used to make mucin.
- It takes energy to put the mucin together and to transport it across the gut wall into the lumen using sodium as a carrier.
- The pancreas secretes sodium to raise pH thus reducing amino acid solubility.
- The protein and energy that should have gone to the birds growth has been lost due to inflammation from phytate.

INFLAMMATION LEADS TO WET LITTER ISSUES

- Mucin and sodium cause increased water holding by the gut, leading to a Sloppy Gut that can empty onto the floor.
- Resulting in Wet Litter
- Leading to Reduced Growth and FC

PHYTASE OPENED THE DOOR

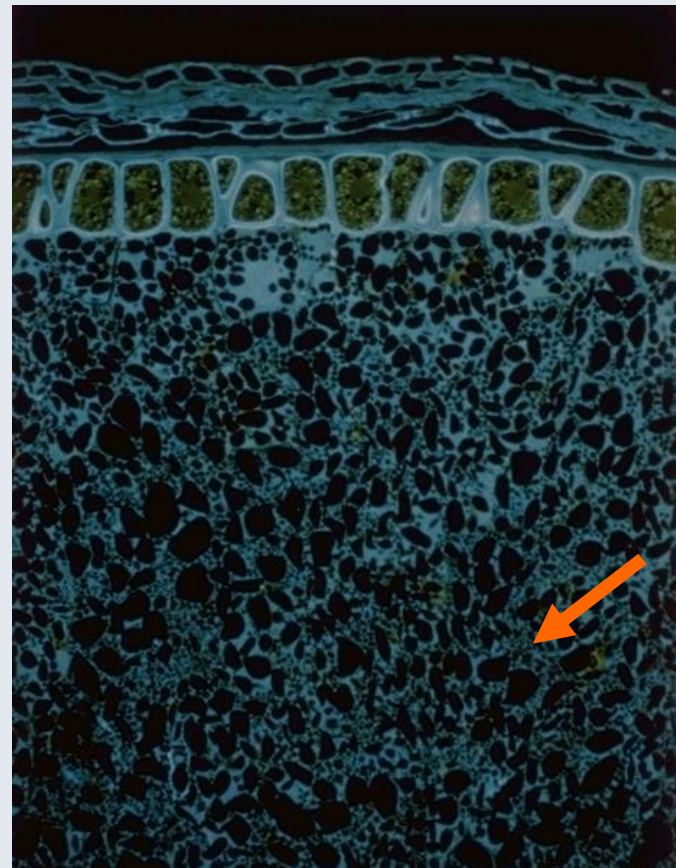
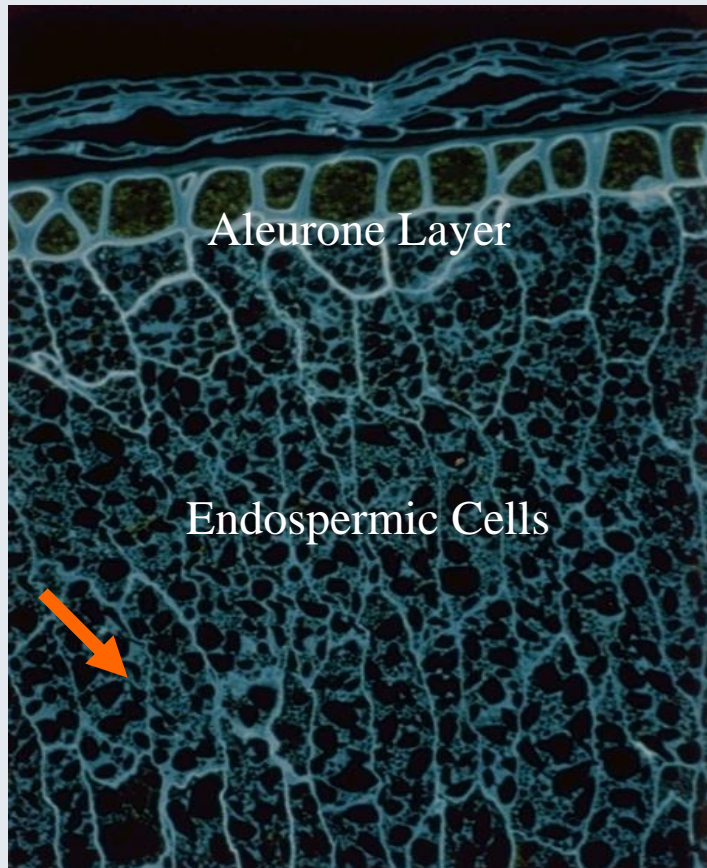
- Today phytase is one of the most researched enzymes in the literature
 - Phytase is used in almost 95+% of poultry diets
- The acceptance of phytase has led to the use and testing of many new enzymes within the US market

WHAT ARE THOSE ENZYMES?

- **Carbohydrases**
 - Xylanase
 - Beta Mannanase
 - Alpha-Galactosidases
 - Glucanase

- **Proteases**

XYLANASE ENZYMES DEGRADE CELL WALL RELEASING STARCH AND ENERGY FOR ANIMAL



XYLANASE

- Xylose or xylan is very high in wheat, midds, DDGS and is also found in corn and SBM.
- Xylose is a soluble fiber that ties up a lot of water in the gut, causing a viscous material to develop resulting in wet litter.
- Impedes feed passage reducing nutrient uptake especially fats by the bird.

MAIN FUNCTION OF XYLANASE

- To breakdown the soluble fiber (xylose) and open up feedstuff cell walls.
- Breaks insoluble fiber into smaller particles resulting in increased lower gut fermentation
- Reduces gut viscosity and wet litter
- Releases some energy and a small amount of protein.
- When formulating using xylanase, only an energy value is used.

ALPHA GALACTOSIDASE

- Mainly for high soybean meal formulas
- SBM has 40% of its carbohydrates that are indigestible. This causes a viscous material in the gut that may lead to looseness in the bird and WET FLOORS.
- This is probably part of the anti-nutritional effects of SBM.

ALPHA GALACTOSIDASE

- **Main function of Alpha Gal**
 - **Is to break down the soluble fiber. Thereby reducing the viscosity of the gut and reducing wet litter.**
 - **By breaking down the soluble fiber there are more digestible nutrients including carbohydrates available to the bird**

ALPHA GALACTOSIDASE

- This is to improve energy utilization and help reduce wet litter .
- Reduce production cost.

BETA MANNANASE

- β -Mannan-antinutritive fiber found in soybean meal
- β -Mannan looks like an invading pathogen
- Turkey responds with an immune response which uses energy and protein

BETA MANNANASE

- Main Function

- Breaks down the β -Mannan
- Prevents the immune response
- Spares the protein and energy
- Improved growth and feed efficiency

PROTEASE

- Only a few in the feed industry today
- Not being used by many companies in the USA, yet.

PROTEASE

- What does a protease do?
 - Breaks peptide bonds between amino acids.
 - Endogenous proteases like trypsin and pepsin have very specific functions in digestion.
 - Exogenous proteases are more broad spectrum.

PROTEASE

- **Practical Application**
 - Improve Protein Digestion
 - Reduce Added Protein
 - Reduce Ammonia Levels
 - Improve Growth and FC
- Claim to improve COCCI Protection
- Claim to help during Heat Stress
- **REDUCE FEED COST**

WHERE DO WE GO FROM HERE??

- **Proteases:** to improve amino acid availability, growth, feed conversion and reduce cost
- **Combination Enzymes:** to improve growth, feed conversion and reduce cost
- **New enzymes are being discovered almost daily**

SUMMARY

- **Enzymes:**
 - **Are proteins**
 - **Break down undigestible starch, protein and phosphorus**
 - **Lower gut maintenance by increasing digestion**
 - **Prevent immune response**
 - **Reduce wet litter**
 - **Improve production cost through reduced feed cost or improved performance**

SUMMARY

- **With the high price of feed ingredients:**
 - **We must get all of the nutrients possible out of those ingredients**
 - **Enzymes will play a major role in wringing every nutrient out of the feed**

QUESTIONS?