

Swine Phytase Feeding

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INTRODUCTION

- Phosphorus is a critical nutrient required by pigs.
- A significant portion of phosphorus in grains and seeds is bound by phytate.
- Phytate bound phosphorus is largely unavailable to pigs.

INTRODUCTION

- Dietary Phytase:
 - Releases bound phosphorus from grains
 - Increases available phosphorus to the pig
 - Decreases inorganic phosphorus supplementation
 - Diet cost reduced
 - Reduces phosphorus excretion
 - Less land required to handle phosphorus
- Low phytate grains reduce phosphorus excretion
 - Limited supply, commercially
 - Dietary phytase still beneficial

Phosphorus

Phosphorus (P) – Functions

- Skeletal formation – bones and teeth
 - 80% of body's phosphorus
- Cell Structure - phospholipids
- Lean muscle deposition
- Carbohydrate metabolism
 - Production of ATP (Adenosine Tri-Phosphate)
 - Primary source of metabolic energy
- Fat metabolism

Sources of Phosphorus

Ingredient	Total Phosphorus, %
Corn	0.28
Wheat	0.37
Soybean Meal	0.69
Wheat Middlings	0.93
Distiller's Dried Grains w/Solubles	0.69
Meat and Bone Meal	4.63
Fish Meal	3.04
Dicalcium Phosphate	18.5

Source: National Swine Nutrition Guide, 2010

Phosphorus in Feed Ingredients

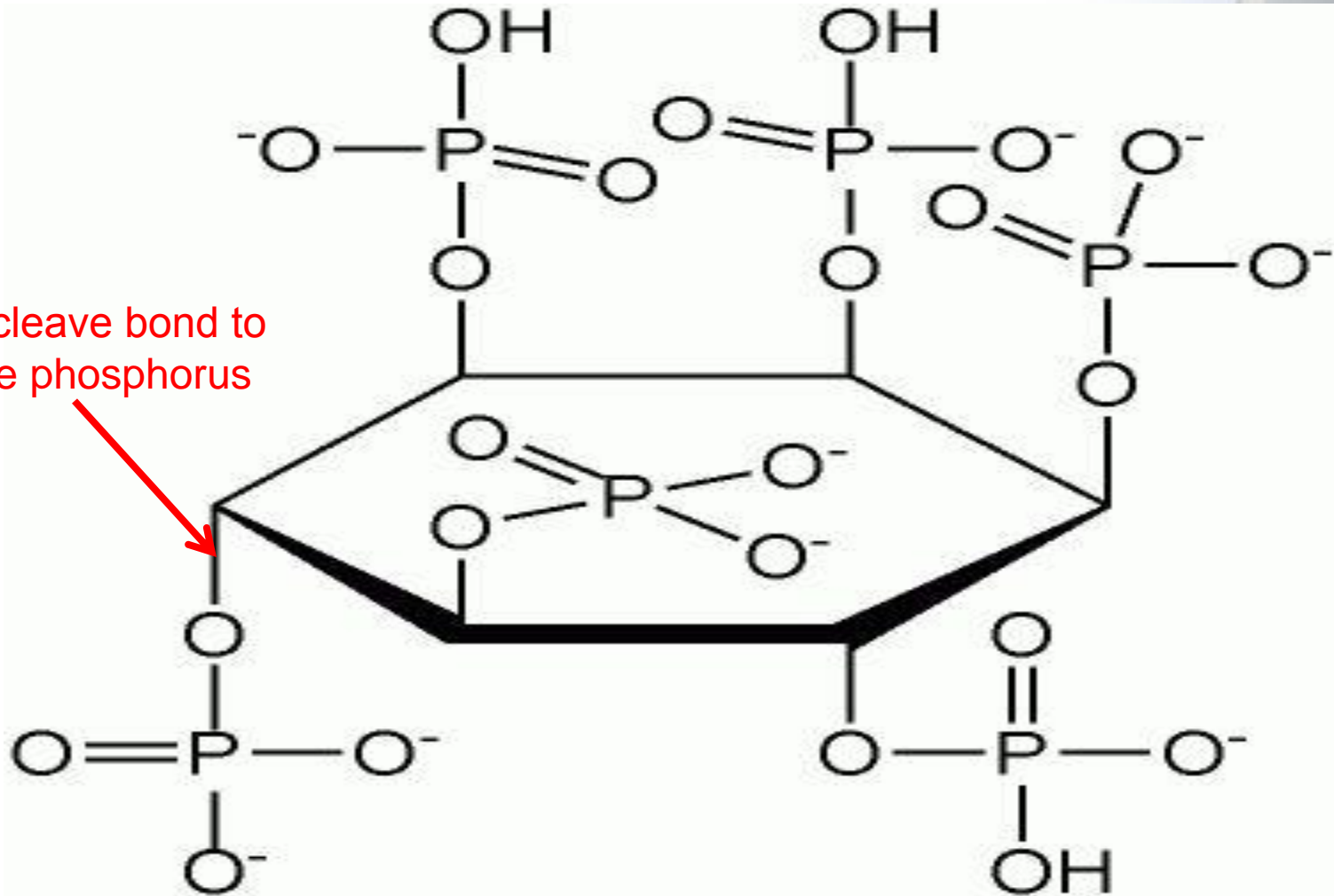
- Not all of the phosphorus in feed ingredients is available to the animal for productive purposes.
- In grains and seeds, this is due to phytate.

What is Phytate?

- Complex molecule that binds phosphorus (and other nutrients) for storage in seeds and grains.
- 60 to 70% of phosphorus in plant based ingredients occurs as phytate phosphorus.
- Phytate P largely unavailable to pigs (Erdman, 1979; Jongbloed and Kemme, 1990; Pallauf and Rimbach, 1997).

Phytate Molecule

Can't cleave bond to
release phosphorus



Ingredients – Available P

Ingredient	Total P, %	P Availability, %	Available P, %
Corn	0.28	14	0.04
Wheat	0.37	50	0.19
Soybean Meal	0.69	23	0.16
Wheat Middlings	0.93	41	0.38
DDGS	0.69	76	0.52
Meat and Bone Meal	4.63	90	4.17
Fish Meal	3.04	93	2.83
Dical Phosphate	18.5	100	18.5

Source: National Swine Nutrition Guide, 2010

Impact of Phytate P on Swine Diets

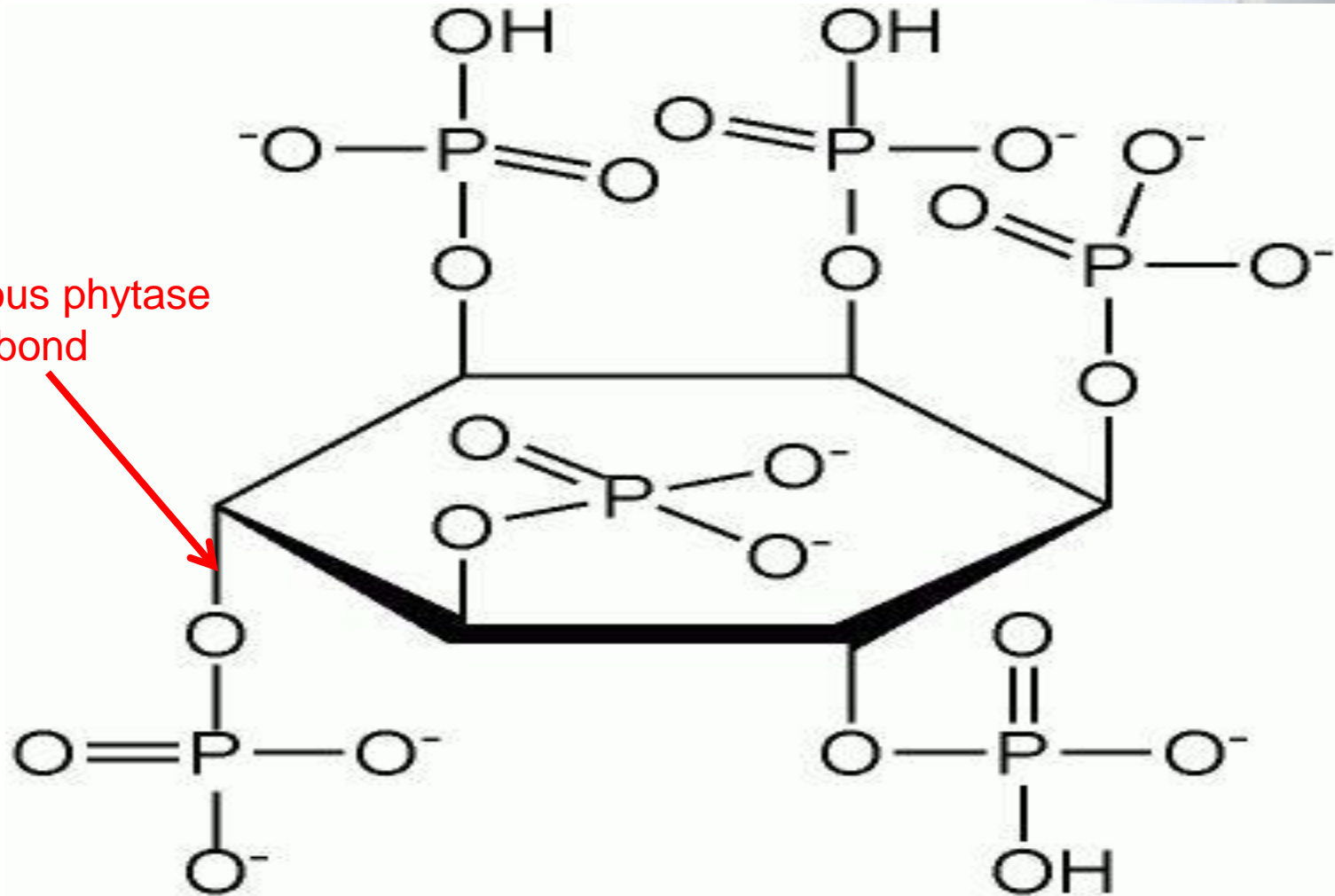
	Dietary Level, %	Total P, %	Phytate P, %	Available P, %
P Requirement:		0.50	-	0.25
Corn	63.65	0.17	0.11	0.03
Soybean Meal	8.00	0.05	0.03	0.02
Wheat Middlings	10.00	0.09	0.08	0.03
DDGS	10.00	0.08	0.02	0.06
Dicalcium Phosphate	0.60	0.11	-	0.11
Non-P Ingredients	7.75	-	-	-
TOTAL	100	0.50	0.24	0.25

Phytase

What is Phytase?

- Enzyme – releases phosphorus
 - Lack of intestinal phytase in the pig
- Exogenous enzyme (added to the diet)
 - Bacterial or fungal
- Release phosphorus (and other nutrients) from phytate in grain and oilseeds
- Phosphorus now “available” for use by the pig to meet requirements

Phytate Molecule

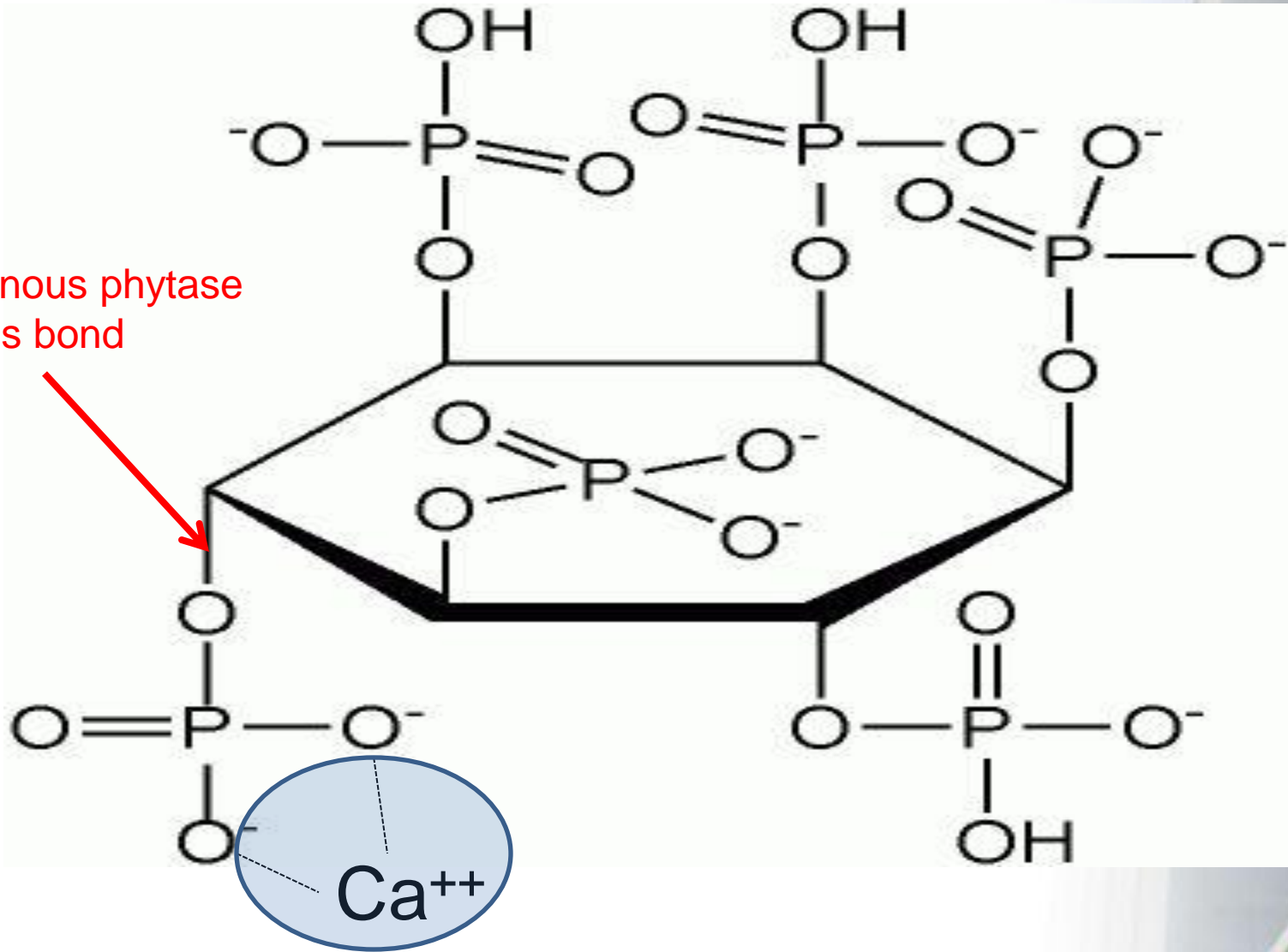


What is Phytase?

- Typically expressed as “Phytase Units” or “FTU” per unit of feed
- 500 FTU (Phytase Units/kg) liberates 0.10% phosphorus
- Also liberates calcium (bone) and other nutrients

Phytate Molecule

Exogenous phytase
cleaves bond



Impact of Phytase on Swine Diets

	Dietary Level, %	Total P, %	Phytate P, %	Available P, %
P Requirement:		0.50	-	0.25
Corn	65.20	0.17	0.11	0.08
Soybean Meal	7.35	0.05	0.03	0.03
Wheat Middlings	10.00	0.09	0.08	0.06
DDGS	10.00	0.08	0.02	0.07
Dicalcium Phosphate	0.05	0.01	-	0.01
Phytase	0.005	-	-	-
Other Ingredients	7.40	-	-	-
TOTAL	100	0.40	0.24	0.25

Available P Comparison

	No Phytase	Phytase
	Available P, %	
Corn	0.03	0.08
Soybean Meal	0.02	0.03
Wheat Middlings	0.03	0.06
DDGS	0.06	0.07
Dicalcium Phosphate	0.11	0.01
Phytase	-	-
Other Ingredients	-	-
TOTAL	0.25	0.25

Diet Comparison- Phytase

	No Phytase	Phytase	Difference
Corn, %	63.65	65.20	+1.55
Soybean Meal, %	8.00	7.35	-0.65
Wheat Middlings, %	10.00	10.00	-
DDGS, %	10.00	10.00	-
Dicalcium Phosphate, %	0.60	0.05	-0.55
Phytase, %	-	0.005	+0.005
Total Phosphorus	0.50	0.40	-.10
Available Phosphorus	0.25	0.25	-

Phytase – Pig Performance/P Excretion^a

	No Phytase	+ Phytase
Diet P, %:^b	0.50/0.45/0.40	0.40/0.35/0.30
Daily Gain, kg	0.85	0.84
Feed:Gain, lb/lb	2.94	2.88
Femur Bone Strength, kg	209	202
P Digestibility, %	33	45
P Excreted, g/d	8.1	5.0
P Excretion Reduction	-	38%

^aPigs 28 to 113 kg.

^bDietary P in 3 feed phases.

Source: Cromwell et al., 1991

Manure P Excretion and Land Required: Manure Stored and Incorporated

Diet Type	Manure P Excretion, lb P_2O_5 /year	Land Required to Manage P, Acres
Normal Corn-SBM	13,000	257
Reduced P Diet (-0.10%)	8,900 (-31.5%)	177

^a1,000 head capacity pig-finishing facility

^bCorn (170 bu/acre) and soybeans (50 bu/acre)

^cSource: Reese and Koelsch, 1999

Manure P Excretion and Land Required: Anaerobic Lagoon and Pivot Irrigation

Diet Type	Manure P Excretion, lb P_2O_5 /year	Land Required to Manage P, Acres
Normal Corn-SBM	13,000	90
Reduced P Diet (-0.10%)	8,900 (-31.5%)	62

^a1,000 head capacity pig-finishing facility

^bCorn (170 bu/acre) and soybeans (50 bu/acre)

^cSource: Reese and Koelsch, 1999

Phytase – Effect on P Excretion

Item	No Phytase	+ Phytase (510 FTU/kg)	Change, %
P Intake, g/d	5.58	5.58	-
Fecal P, g/d	3.70	3.07	-17.0
Urine P, g/d	0.07	0.07	-
Total Excreted P, g/d	3.76	3.14	-16.5
Digested P, %	34.1	44.9	+10.8

Hill et al., 2008

Economics of Using Phytase

- Early exogenous phytase use (early 1990's):
 - Does it really work?
 - Increased diet cost.
 - Value from reduced P excretion?
- Phosphorus prices increased due to increased demand for inorganic phosphorus for animals and plants (Cordell et al., 2000).

Economics of Using Phytase

	No Phytase	Phytase	Difference
Corn, %	63.65	65.20	+1.55
Soybean Meal, %	8.00	7.35	-0.65
Wheat Middlings, %	10.00	10.00	-
DDGS, %	10.00	10.00	-
Dicalcium Phosphate, %	0.60	0.05	-0.55
Phytase, %	-	0.005	+0.005
Total Phosphorus, %	0.50	0.40	-0.10
Available Phosphorus, %	0.25	0.25	-
Diet Cost, \$/ton	\$332.07	\$327.79	-\$4.28

Low Phytate Grains

- Low phytate grains
 - Improved phosphorus availability
 - Decreased P excretion

- Low Phytate Grains + Phytase:
 - Phytase supplementation further improves performance

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