

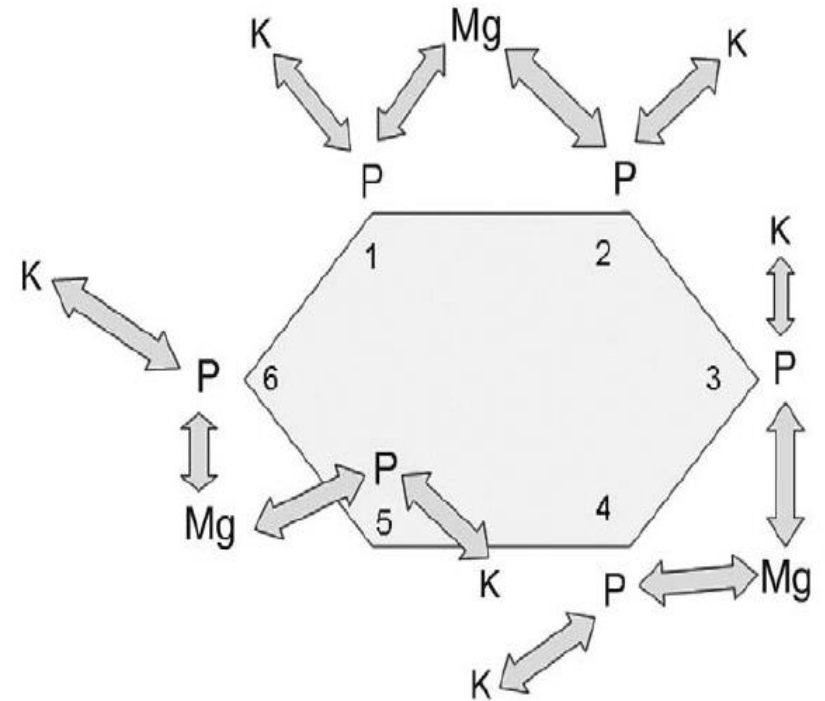
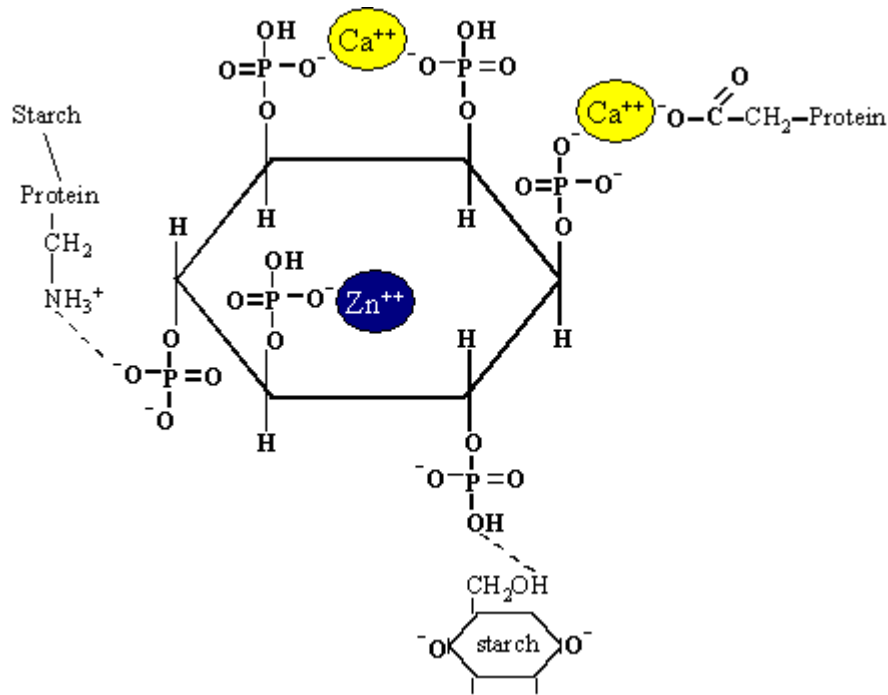


Phytate

Anuraga Jayanegara



Phytate structure



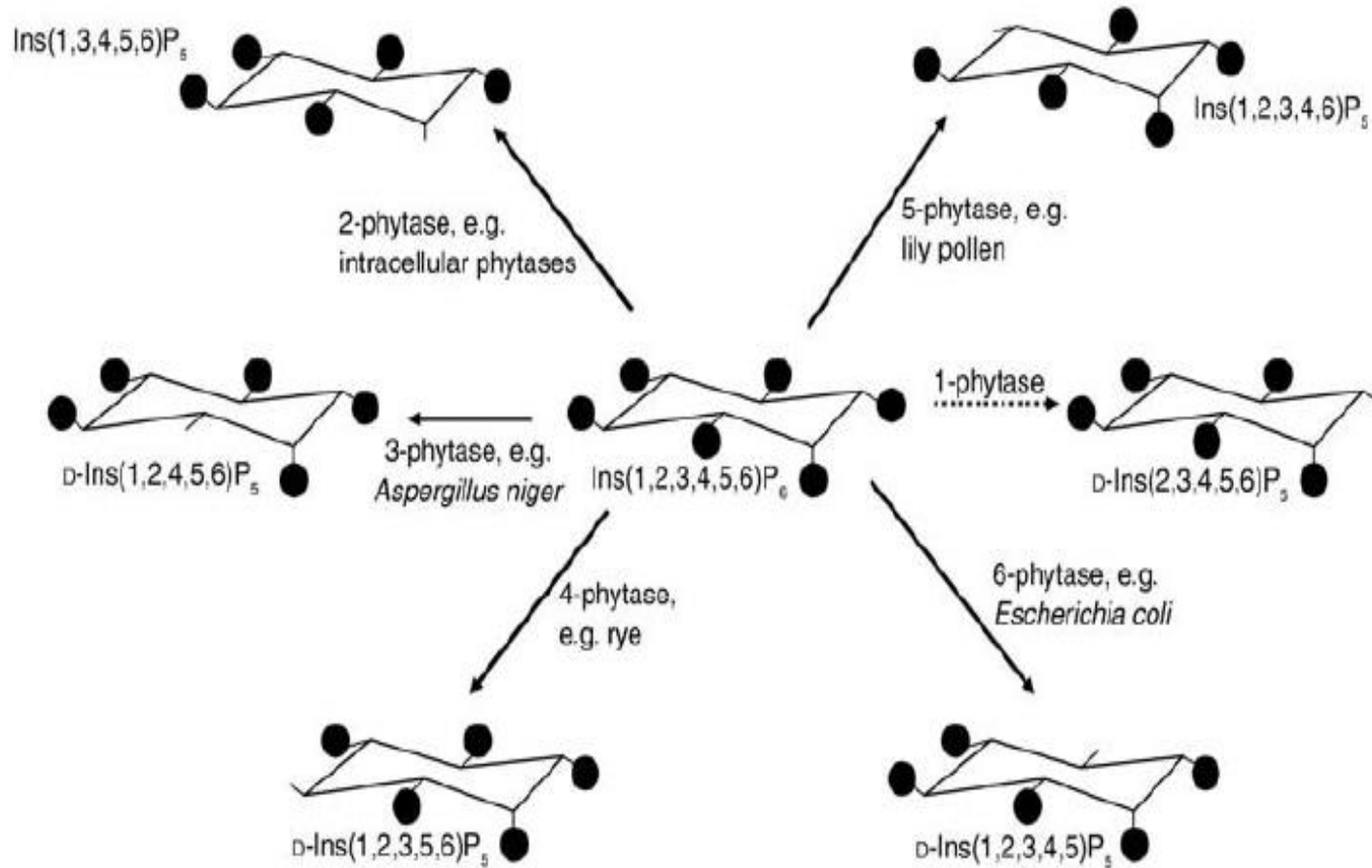


Fig. 5.2. Classification of phytases based on the carbon in the *myo*-inositol ring of phytate at which dephosphorylation is initiated (●, phosphate residue).



Phytases

Phytases are capable of initiating the stepwise dephosphorylation of phytate, myo-inositol (1,2,3,4,5,6) hexakisphosphate

Classification

Based on the catalytic mechanism:

- (1) Histidine acid phytases (HAPhy)
- (2) β -propeller phytases (BPPhy)
- (3) Cysteine phytases (CPhy)
- (4) Purple acid phytases (PAPhy)

Phytase as an additive

Small intestine of monogastrics has only a very limited ability to hydrolyse phytate --> lack of endogenous phytase activity and low microbial population in the upper part of the digestive tract --> phytate P is poorly available to monogastric animals



Benefits

- (1) Increase P utilisation
- (2) Reduce P excretion from animal waste
- (3) Might improve amino acid availability --> phytate-protein interaction may induce changes in protein structure that can decrease enzymatic activity, protein solubility and proteolytic digestibility
- (4) Improve utilisation of minerals
- (5) Increase energy utilisation in monogastric animals



Table 7.1. Mean (and range) of total P and phytate-P concentrations, proportion of phytate-P in total P and bioavailability of total P for pigs in common feed ingredients.

Feed ingredient	Data sets/ samples ^a (n)	Total P ^a (g kg ⁻¹) (range in parentheses)	Phytate-P ^a (g kg ⁻¹) (range in parentheses)	Phytate-P ^a (proportion of total P) (%)	P bioavailability for pigs ^b (%)
Barley	4/41	3.21 (2.73–3.70)	1.96 (1.86–2.20)	61.0	30.0
Maize	7/45	2.62 (2.30–2.90)	1.88 (1.70–2.20)	71.6	13.0
Sorghum	6/64	3.42 (2.71–3.80)	2.66 (1.90–3.26)	77.8	20.0
Wheat	6/97	3.07 (2.90–4.09)	2.19 (1.80–2.89)	71.6	49.0
Canola meal	4/28	9.72 (8.79–11.50)	6.45 (4.00–7.78)	66.4	21.0
Cottonseed meal	3/21	10.02 (6.40–11.36)	7.72 (4.9–9.11)	77.1	1.0
Soybean meal	6/89	6.49 (5.70–6.94)	3.88 (3.54–4.53)	59.9	27.0
Rice bran	6/37	17.82 (13.40–27.19)	14.17 (7.90–24.20)	79.5	25.0
Wheat bran	6/25	10.96 (8.02–13.71)	8.36 (7.00–9.60)	76.3	41.0

^aWeighted means derived from Nelson *et al.* (1968a); Doherty *et al.* (1982); Kirby and Nelson (1988); Eeckhout and de Paepe (1994); Ravindran *et al.* (1994); Mahgoub and Elhag (1998); Viveros *et al.* (2000); Selle *et al.* (2003b); Godoy *et al.* (2005).

^bFrom Cromwell (1992).

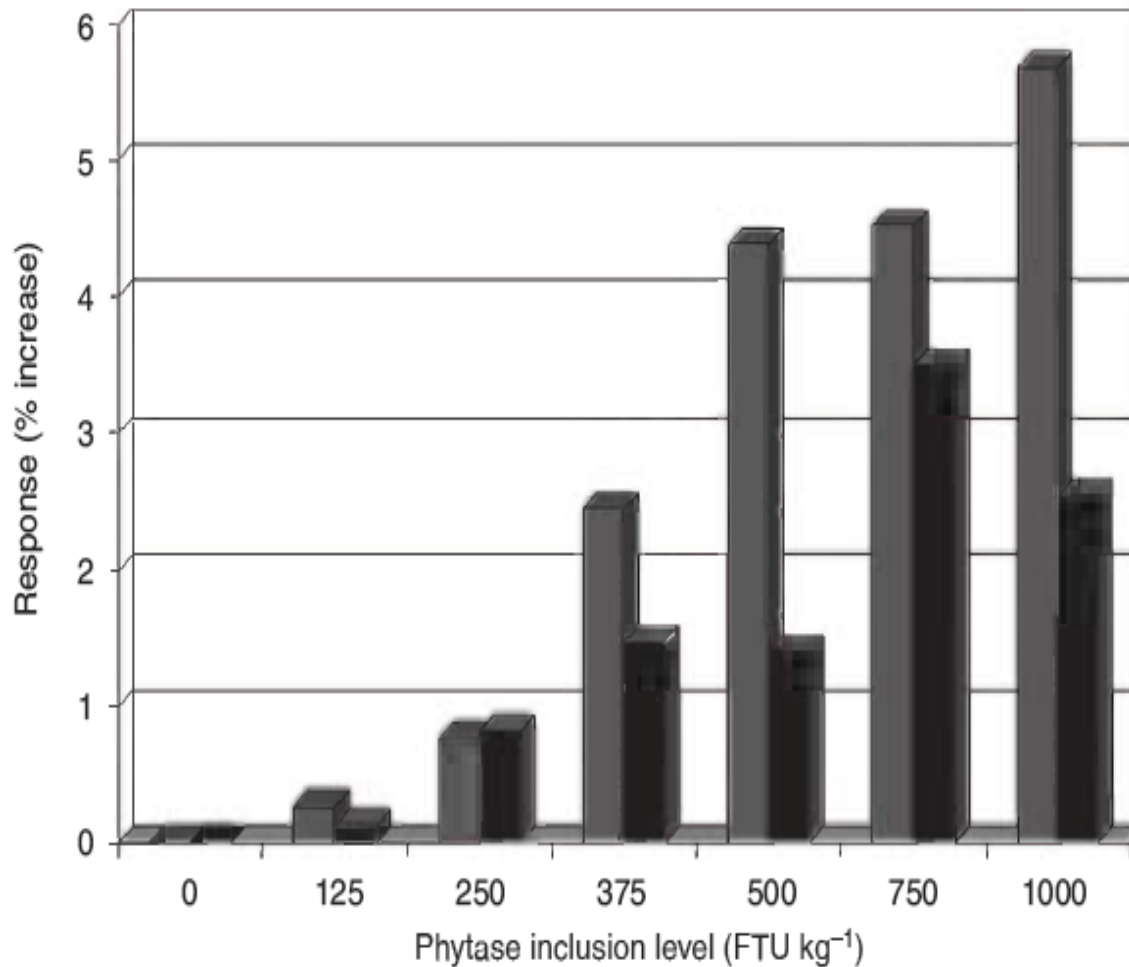


Fig. 7.2. Responses (% increase) in average apparent ileal digestibility of 15 amino acids (grey) and available metabolizable energy (black) to graded phytase inclusion levels (FTU kg⁻¹) in broilers. FTU, phytase units. (From Ravindran *et al.*, 2001.)



Table 7.3. Overall effects of microbial phytase on apparent ileal digestibility (AID) of amino acids from eight assays^a where broilers were offered complete diets with acid-insoluble ash or titanium oxide as dietary marker.

Amino acid	Number of observations	Average AID coefficients		Response (%)
		Nil	Phytase	
<i>Essential</i>				
Arginine	8	0.846	0.870	2.8
Histidine	8	0.778	0.821	5.5
Isoleucine	8	0.784	0.824	5.1
Leucine	8	0.801	0.838	4.6
Lysine	8	0.829	0.862	4.0
Methionine	5	0.894	0.910	1.8
Phenylalanine	8	0.804	0.844	5.0
Threonine	8	0.731	0.783	7.1
Tryptophan	4	0.783	0.818	4.5
Valine	8	0.777	0.814	4.8
<i>Non-essential</i>				
Alanine	7	0.774	0.809	4.5
Aspartic acid	7	0.767	0.814	6.1
Cystine	4	0.673	0.721	7.1
Glutamic acid	7	0.838	0.874	4.3
Glycine	7	0.746	0.788	5.6
Proline	4	0.794	0.835	5.2
Serine	7	0.751	0.804	7.1
Tyrosine	7	0.789	0.808	2.4
Mean	123 (total)	0.787	0.824	4.7

^aRavindran *et al.* (1999a, 2000, 2001, 2006, 2008); Rutherford *et al.* (2002); Selle *et al.* (2003b, 2009b).

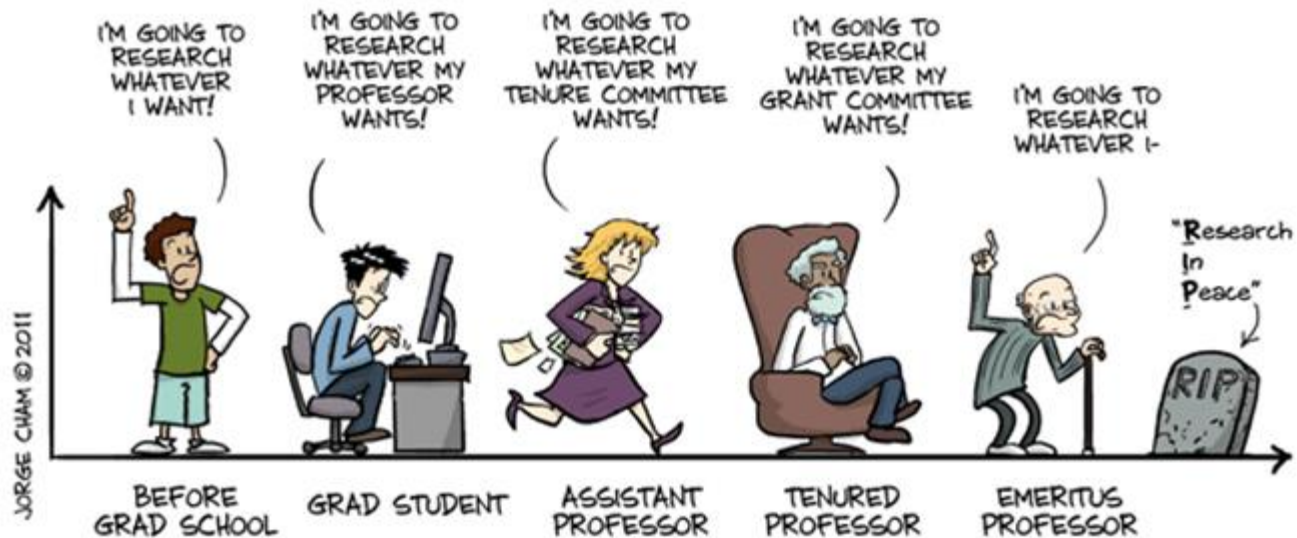


Table 7.4. Impact of microbial phytase on apparent ileal digestibility (AID) coefficients of amino acids where ileal digesta samples were taken from euthanized pigs (adapted from Officer and Batterham, 1992a,b; Kornegay *et al.*, 1998).

Amino acid	Officer and Batterham (1992a,b)			Kornegay <i>et al.</i> (1998)		
	Control	(1000 FTU) Phytase	Response (%)	Control	(500 FTU) Phytase	Response (%)
<i>Essential</i>						
Arginine	–	–	–	0.816	0.879	7.7
Histidine	0.57	0.69	21.1	0.790	0.850	7.6
Isoleucine	0.65	0.72	10.8	0.724	0.819	13.1
Leucine	0.64	0.72	12.5	0.787	0.828	5.2
Lysine	0.59	0.71	20.3	0.720	0.840	16.7
Methionine	0.71	0.75	5.6	0.761	0.832	9.3
Phenylalanine	0.67	0.74	10.5	0.770	0.837	8.7
Threonine	0.50	0.62	24.0	0.648	0.753	16.2
Valine	0.63	0.70	11.1	0.715	0.803	12.3
<i>Non-essential</i>						
Alanine	–	–	–	0.729	0.795	9.1
Aspartic acid	–	–	–	0.745	0.833	11.8
Cystine	0.68	0.81	19.1	0.688	0.772	12.2
Glutamic acid	–	–	–	0.806	0.847	5.1
Glycine	–	–	–	0.603	0.660	9.5
Proline	–	–	–	0.770	0.798	3.6
Serine	–	–	–	0.750	0.819	9.2
Tyrosine	0.63	0.69	9.5	0.719	0.797	10.9

Thank you for your attention!

THE EVOLUTION OF INTELLECTUAL FREEDOM



WWW.PHDCOMICS.COM