School of Biology
Faculty of Biological Sciences

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The Effect of Xylanase and Phytase Supplementation on Performance and Egg Quality in Laying Hens

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Introduction

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- Phytate phosphorus (P) is essentially unavailable for digestion and absorption by non-ruminants.

- Phytate is an anti-nutrient which can chelates with cations, form insoluble phytate complexes and reduce nutrient utilisation.

- Exogenous phytases are now routinely added to low P diets improving phytate P bioavailability and reducing P excretion in faeces.

High phytase levels

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- Nutrient utilisation of wheat-barley based diets can be limited due to the presence of NSP.

- Xylanase degrades arabinoxylans in the cell wall, releasing encapsulated starch and other nutrients from inside the cell wall, at the same time as reducing digesta viscosity.

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- Gut health – selective promotion of advantageous microflora

- Peptide YY is a hormone produced primarily by endocrine cells in the ileum and colon
  - Slows down gastric emptying and intestinal transit time enhancing nutrient digestion.

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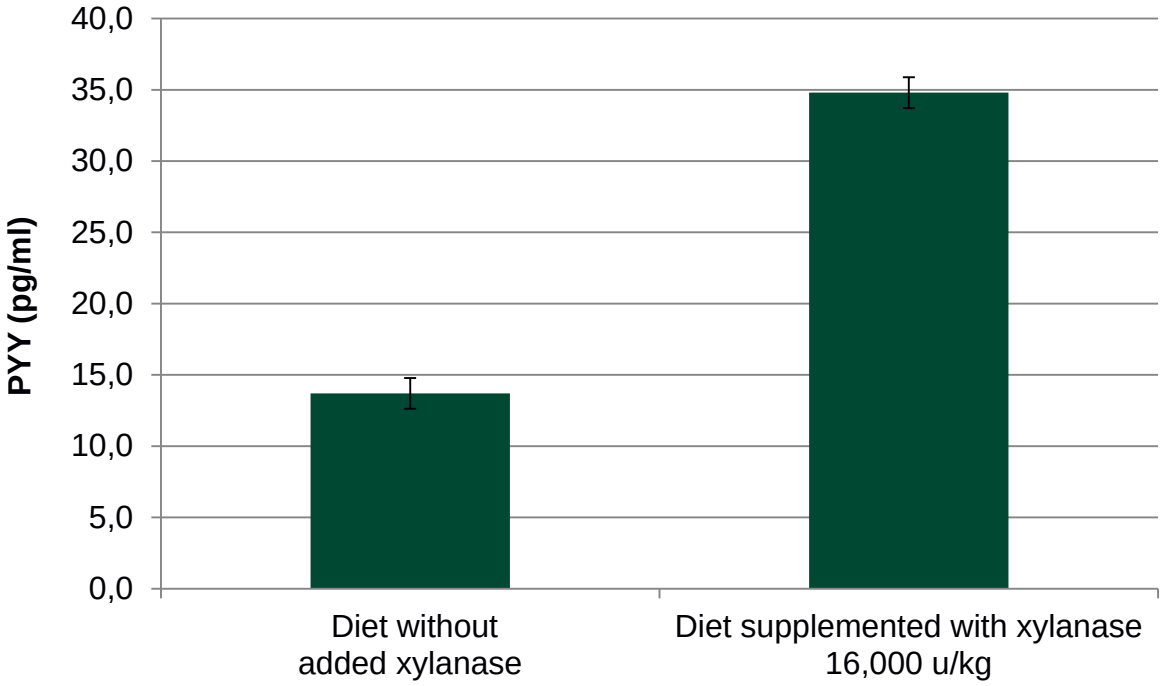
- Studies in broiler chickens have investigated the effects of xylanase on peptide YY concentrations (Singh et al, 2012).



Phytase x Xylanase

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Objectives:

1. To evaluate the effects of xylanase (Econase XT) and phytase (Quantum Blue) at conventional or high levels on laying hen performance, egg quality, phytate breakdown and blood concentration of PYY.

2. To investigate the interactive effects of xylanase and phytase, at conventional or high levels, on layer hen performance, egg quality, phytate breakdown and blood concentration of PYY.

Phytase x Xylanase

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- **Phytase** - will increase the breakdown of phytate and make phytate bound P more available.
- It will also reduce the antinutritional factor potential of phytate and at the superdose level should produce extra phosphoric effects.

- **Xylanase** - reduce the NSPs in the diet, creating shorter chain oligosaccharides and altering caecal fermentation.
- Changes in caecal fermentation will increase PYY.

- **Phytase x Xylanase -** produce complimentary effects as the increased retention time resulting from xylanase inclusion should allow phytase to be more effective and increase the level of breakdown of phytate.

Methods

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- A total of 240 Bovan Brown hens were used starting the experiment at 22 weeks of age.
  - Birds remained on trial for 24 weeks.
- Hens were allocated to 60 enriched colony cages (63 x 73 cm) with 4 birds per cage creating 10 replicates per treatment.
- 2 x 3 arrangement with phytase (0, 300 or 1,500 FTU/kg Quantum Blue) and xylanase (0 vs. 12,000 BXU/kg Econase XT) as factors.
- Diets were wheat-barley based and formulated to meet or exceed the nutrient requirements of laying hens when the 300 FTU phytase matrix is applied.

AV P 0.172 % **AV P 0.159 %**

Ca 3.75 % **Ca 3.84 %**

Methods

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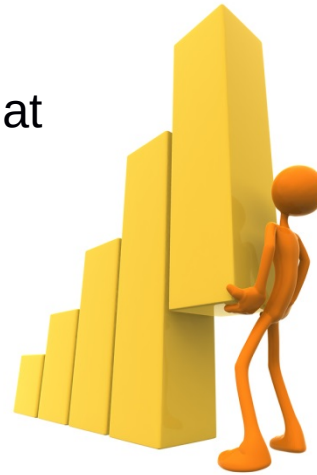
- Hen body weight recorded
- Weekly feed intake and egg production per cage were recorded.
- Egg quality was determined at the end of the trial based on 3 days' egg collection per cage.
  - - egg weight, shell strength, haugh units, yolk weight, yolk colour, shell weight, shell thickness
- 2 birds per cage were killed by schedule I method. Blood was collected at slaughter into heparinised tubes.
  - Chicken Peptide YY(PYY) ELISA kit (CSB-EL019128CH)
- The digesta from the gizzard and ileum was collected.
- Data was analysed for main effects and their interaction overall 24 week period by ANOVA according to a general linear model procedure (SPSS, version 22).



Results - Egg production

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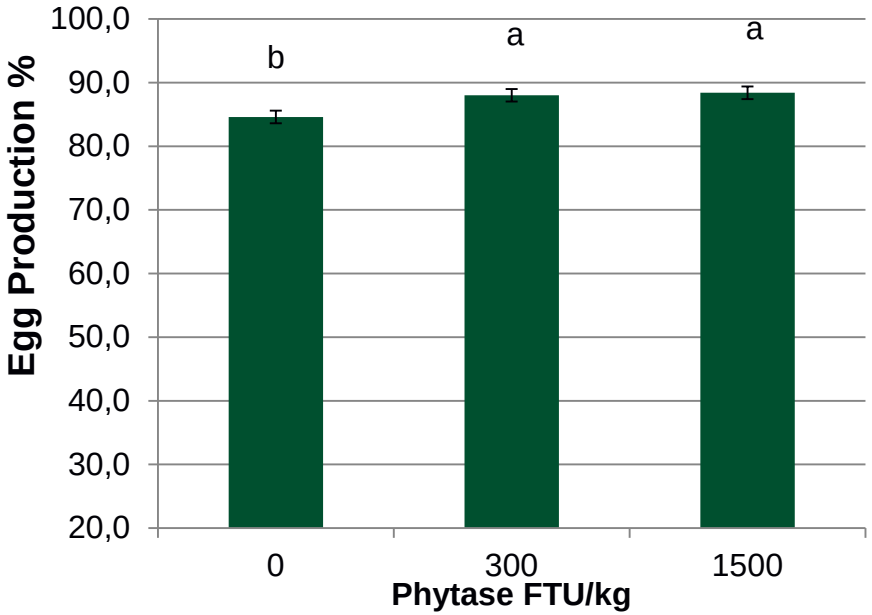

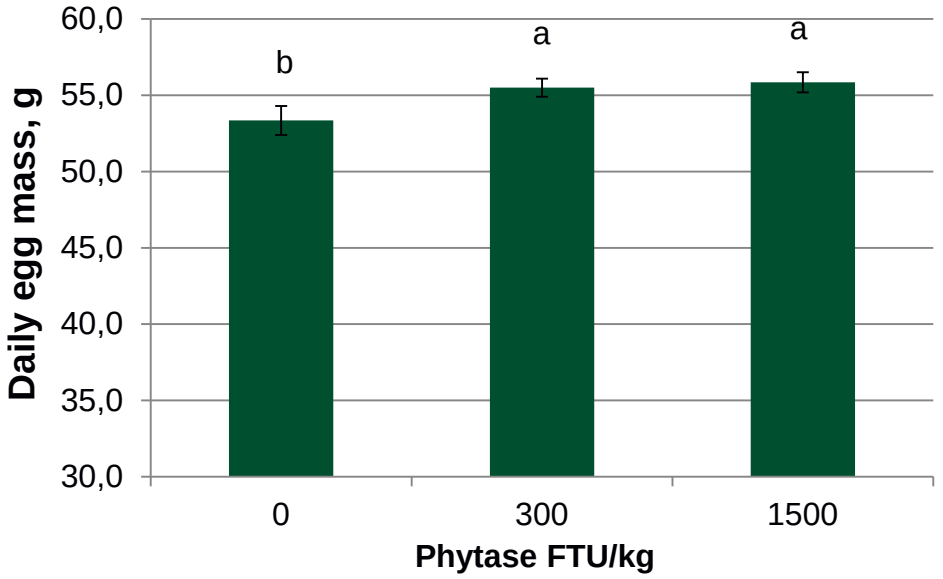

Results - FCR

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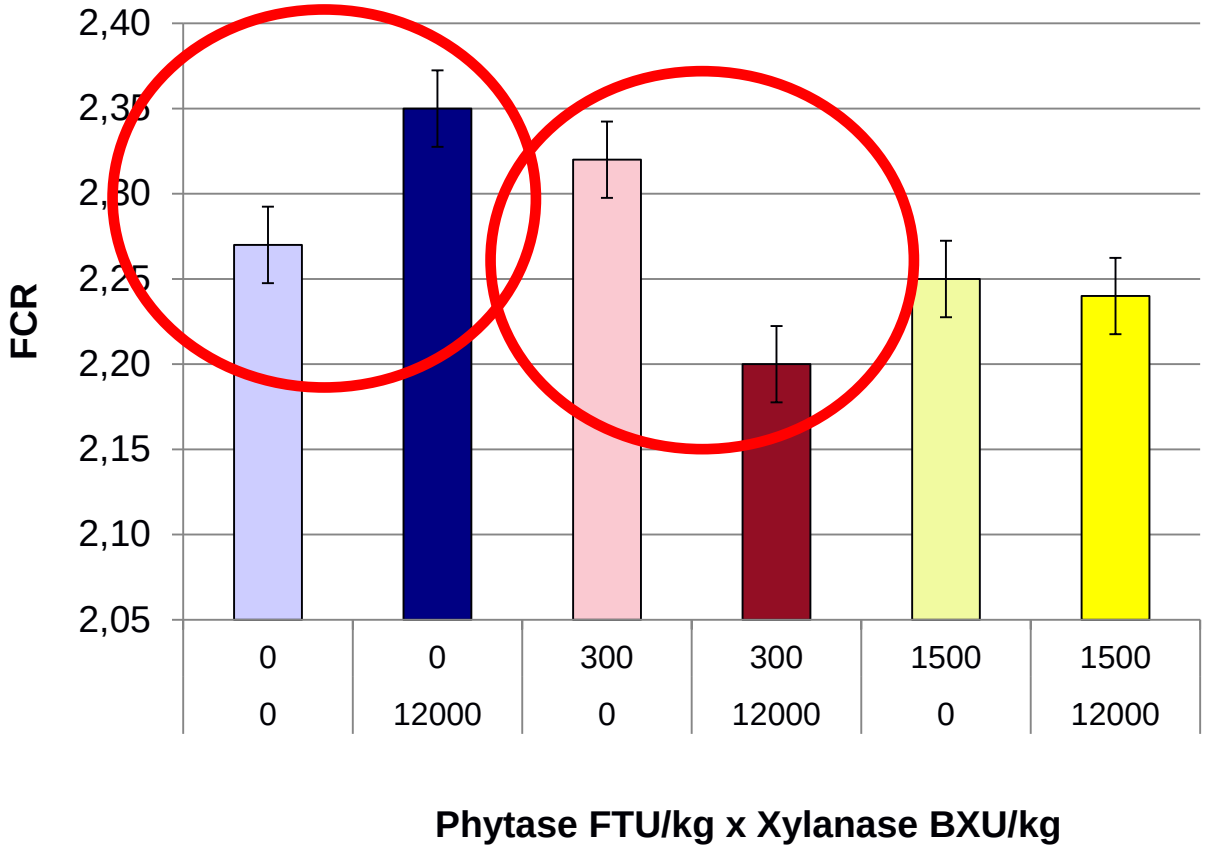

Results - concentrations of inositol phosphates and inositol per mg Ti in gizzard digesta (nmol/mg Ti)

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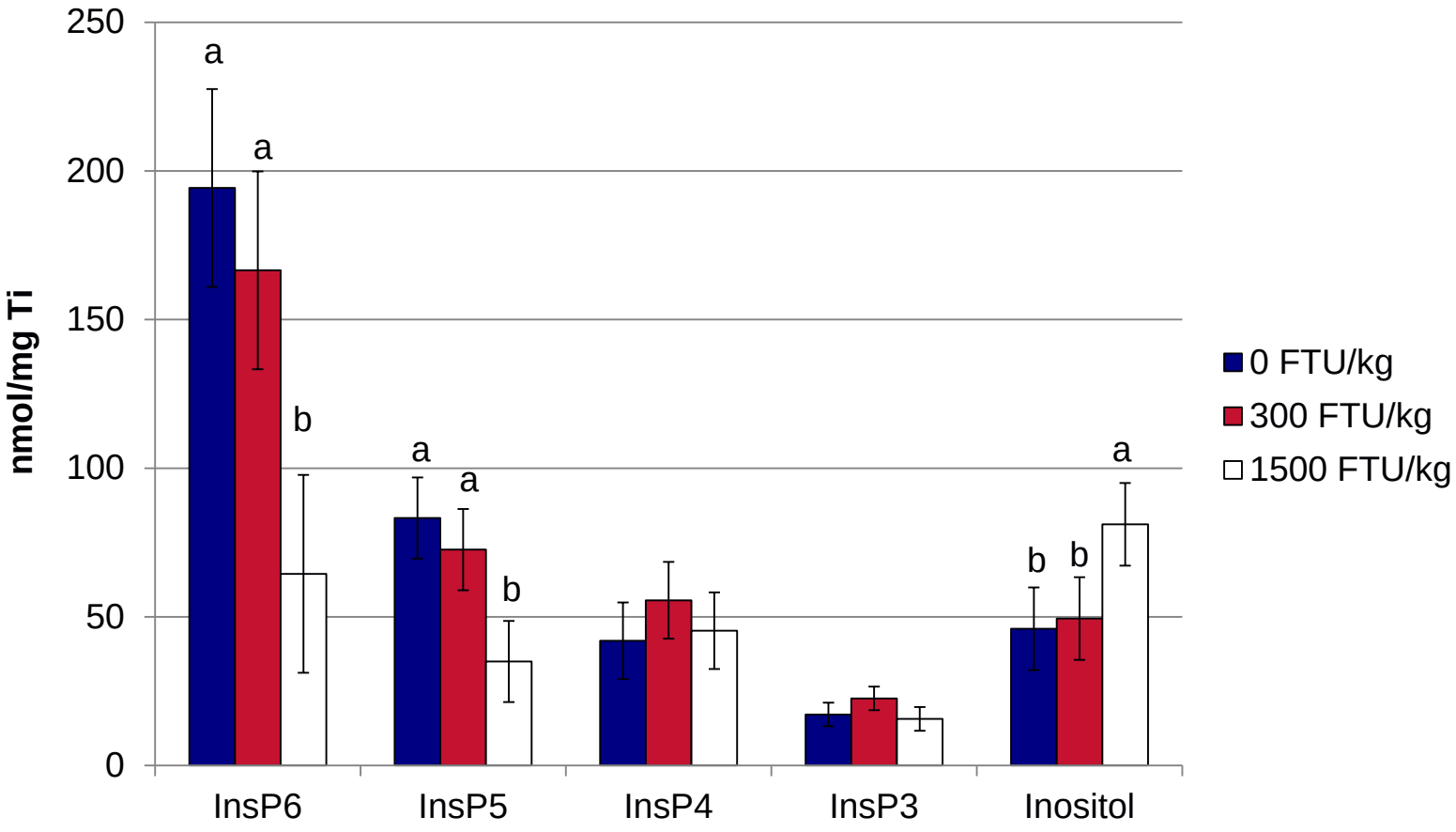

Results - concentrations of inositol phosphates and inositol per mg Ti in ileal digesta (nmol/mg Ti)

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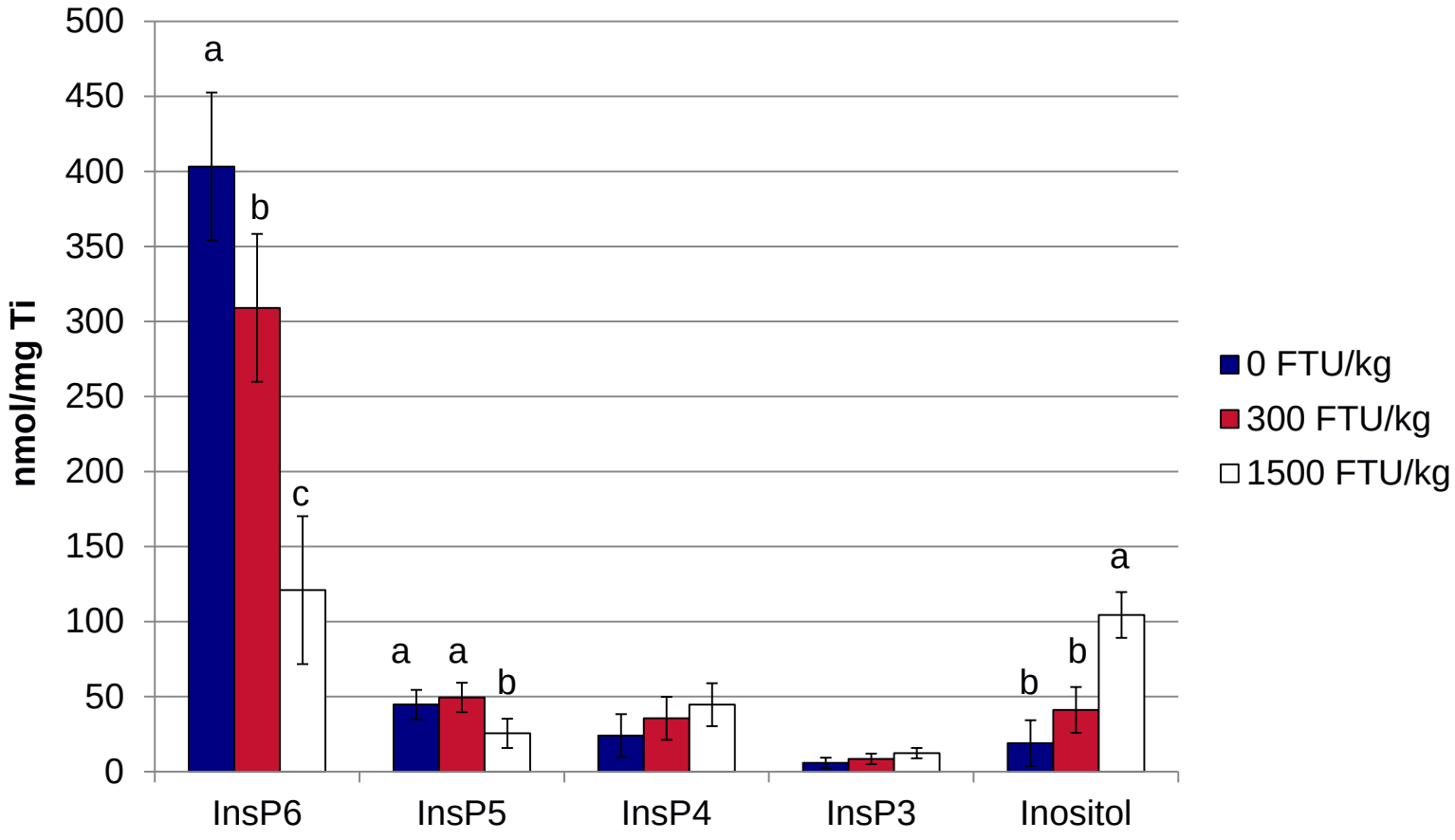

Results – Peptide YY

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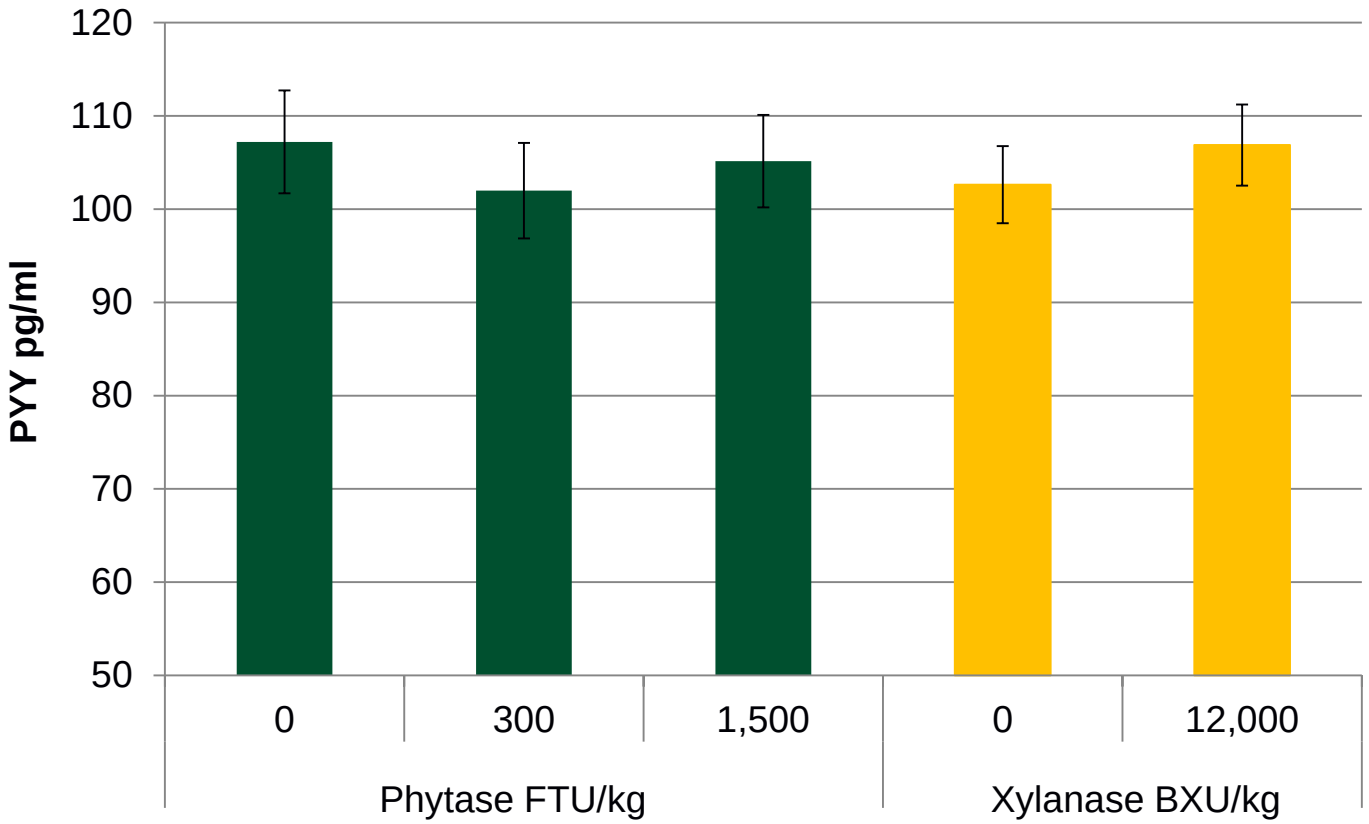

Conclusions

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- Xylanase alone had no effect on laying hen performance.
- Phytase improved egg production and at high phytase levels increased the breakdown of phytate.
- Xylanase improved FCR when conventional levels (300 FTU/kg phytase) of phytase were used.
- Neither phytase nor xylanase had an effect on peptide YY levels.

References

Singh, A., Masey O'Neill, H.V., Ghosh, T.K., Bedford, M.R, Haldar. 2012. Animal Feed Science and Technology. 177. 194-203.

Diet period 1

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Barley	7.5000
Wheat	55.0487
Soya	22.2547
Rapeseed Ext	2.5000
L-Lysine HCl	0.0674
DL-Methionine	0.1567
Limestone Coarse (Bulk)	8.7262
DCP	0.4161
Salt	0.2806
Sodium Bicarb	0.1036
Soya Oil	2.8405
leeds layer supp	0.1000
Target Pigment	0.0055
TOTAL	100.000
DRY_MAT	88.063
OILB	4.993
PROTEIN	17.500
SALT	0.400
CALCIUM	3.735
DG_CALCIUM	3.735
PHOS	0.399
AVPHOS	0.172
DGP_PLTY_C	0.196
SODIUM	0.150
DG_SODIUM	0.150

Diet period 2

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Barley	7.5000
Wheat	55.9721
Soya	20.9687
Rapeseed Ext	2.5000
L-Lysine HCl	0.0614
DL-Methionine	0.1446
Limestone Coarse (Bulk)	9.0060
DCP	0.3598
Salt	0.2817
Sodium Bicarb	0.0835
Soya Oil	2.6167
leeds layer supp	0.1000
Target Pigment	0.0055
Titanium dioxide	0.4000
TOTAL	100.000
DRY_MAT	87.674
OILB	4.839
PROTEIN	17.000
SALT	0.400
CALCIUM	3.835
DG_CALCIUM	3.835
PHOS	0.381
AVPHOS	0.159
DGP_PLTY_C	0.186
SODIUM	0.145

One FTU is defined as the amount of enzyme that liberates 1 µmol of inorganic P from 0.0051 mol L sodium phytate at pH 5.5 and 37˚C per minute.

BXU – is the amount of eno-1,4 ^{2} xylanase that liberates 1 nmol xylose from birch xylan per second at pH 5.3 and 50 ˚C.

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Econase XT is an enzyme with endo-1,4-beta-xylanase as it the main activity and its main function is to break down the fiber fraction from cereals, mainly arabinoxylan

Results - Digestibility

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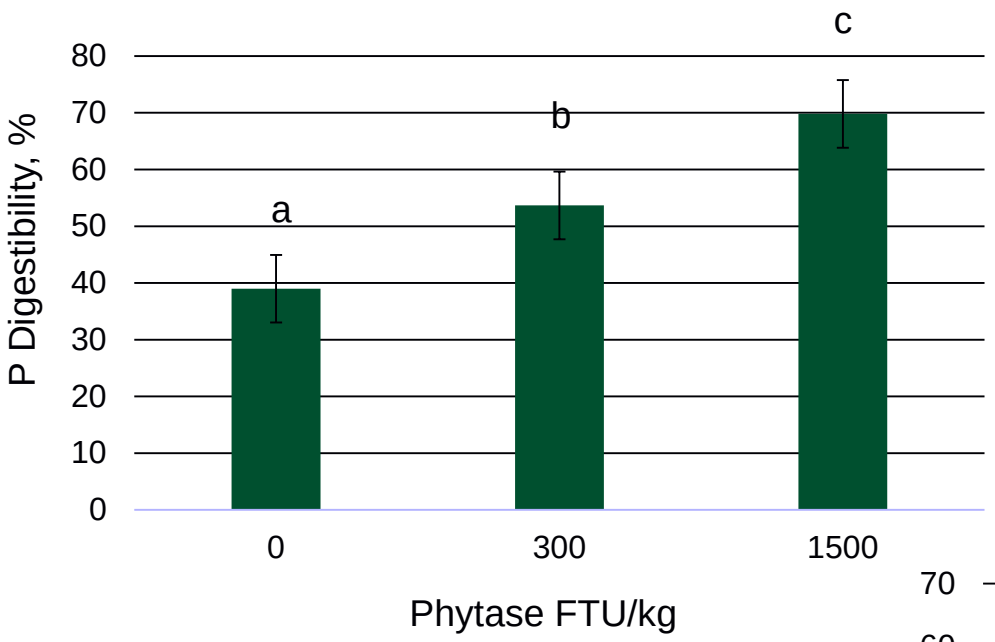

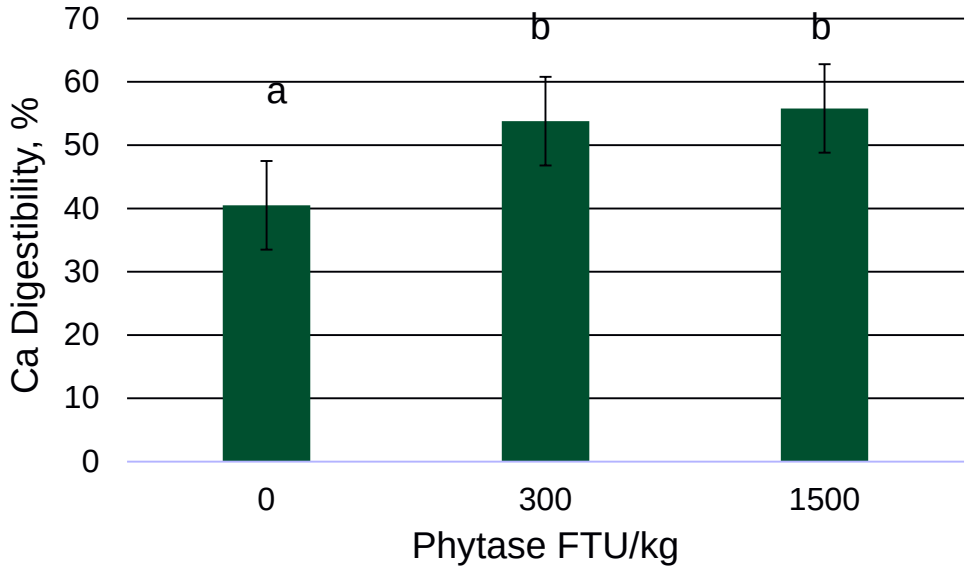

Results - xylanase supplementation on volatile fatty acid concentration in the caeca (mmol/l)

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