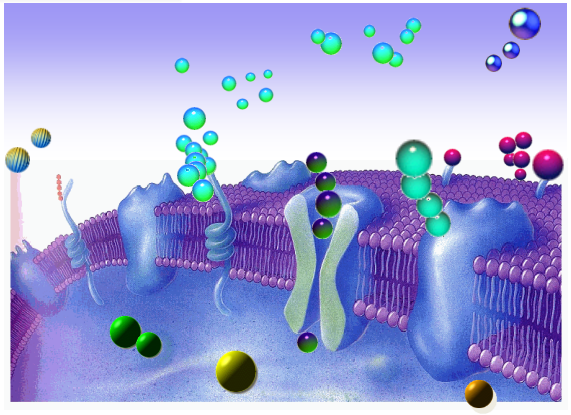
Fiber and nutrient retention responses of supplemental xylanase in broiler chickens fed wheat based diets are independent of the acclimatization period to test diets



E. Kiarie[1], L. Romero[1] and R. Ravindran

[1]Danisco Animal Nutrition, Marlborough, Wiltshire, United Kingdom

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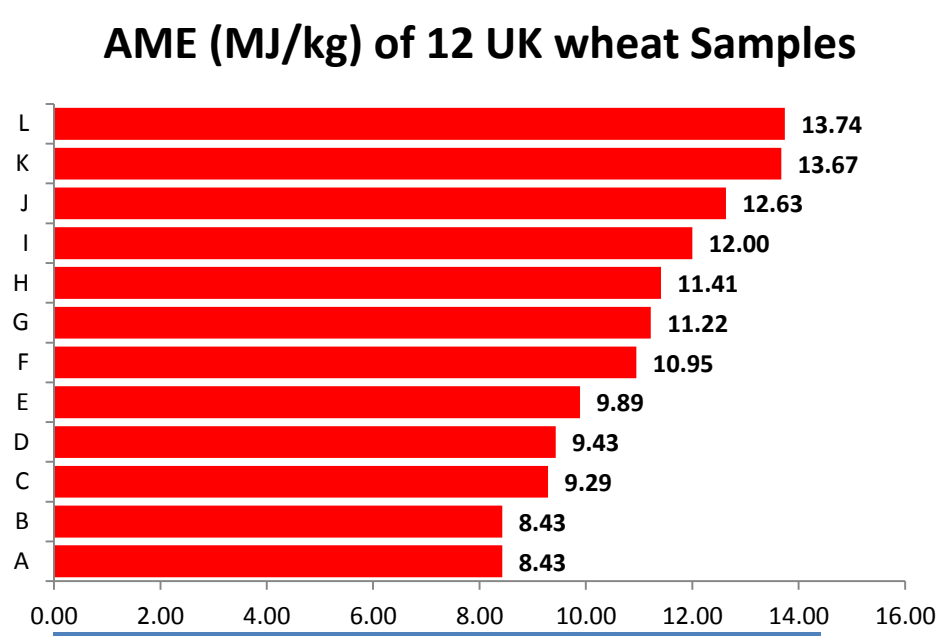
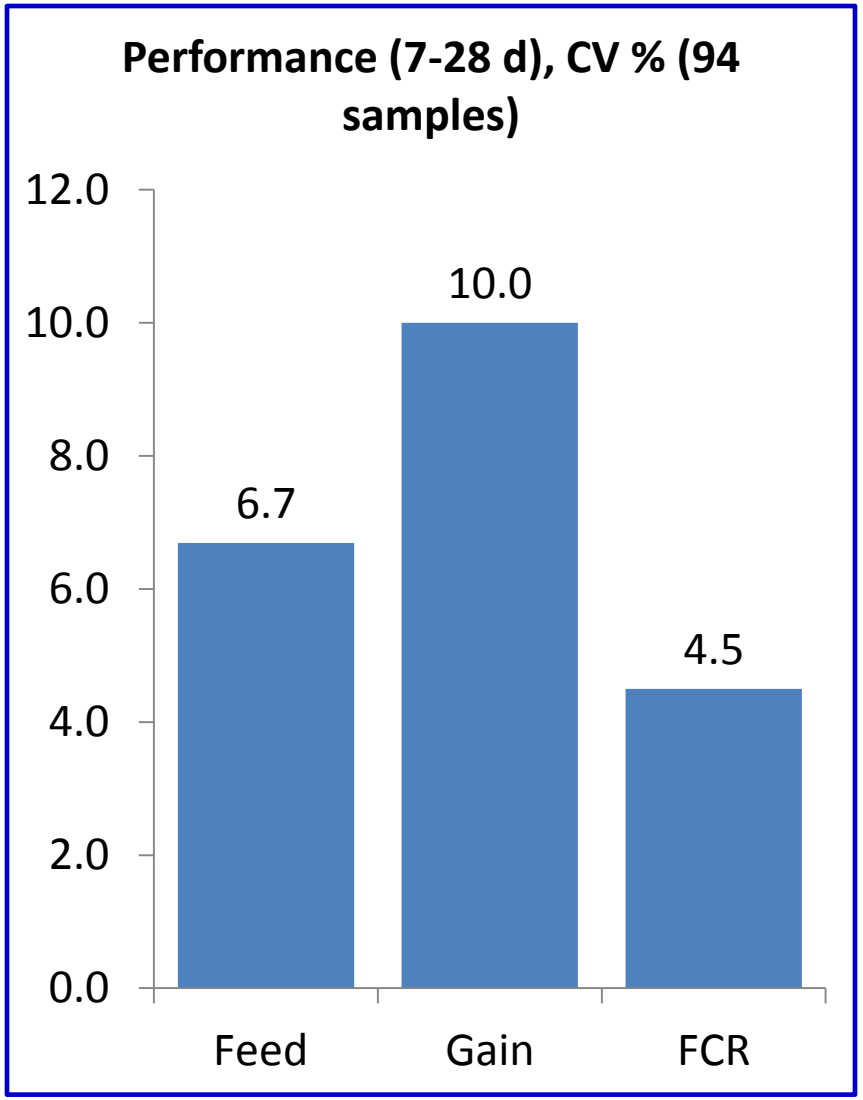
Variability in wheat nutritive value



CV = 16%

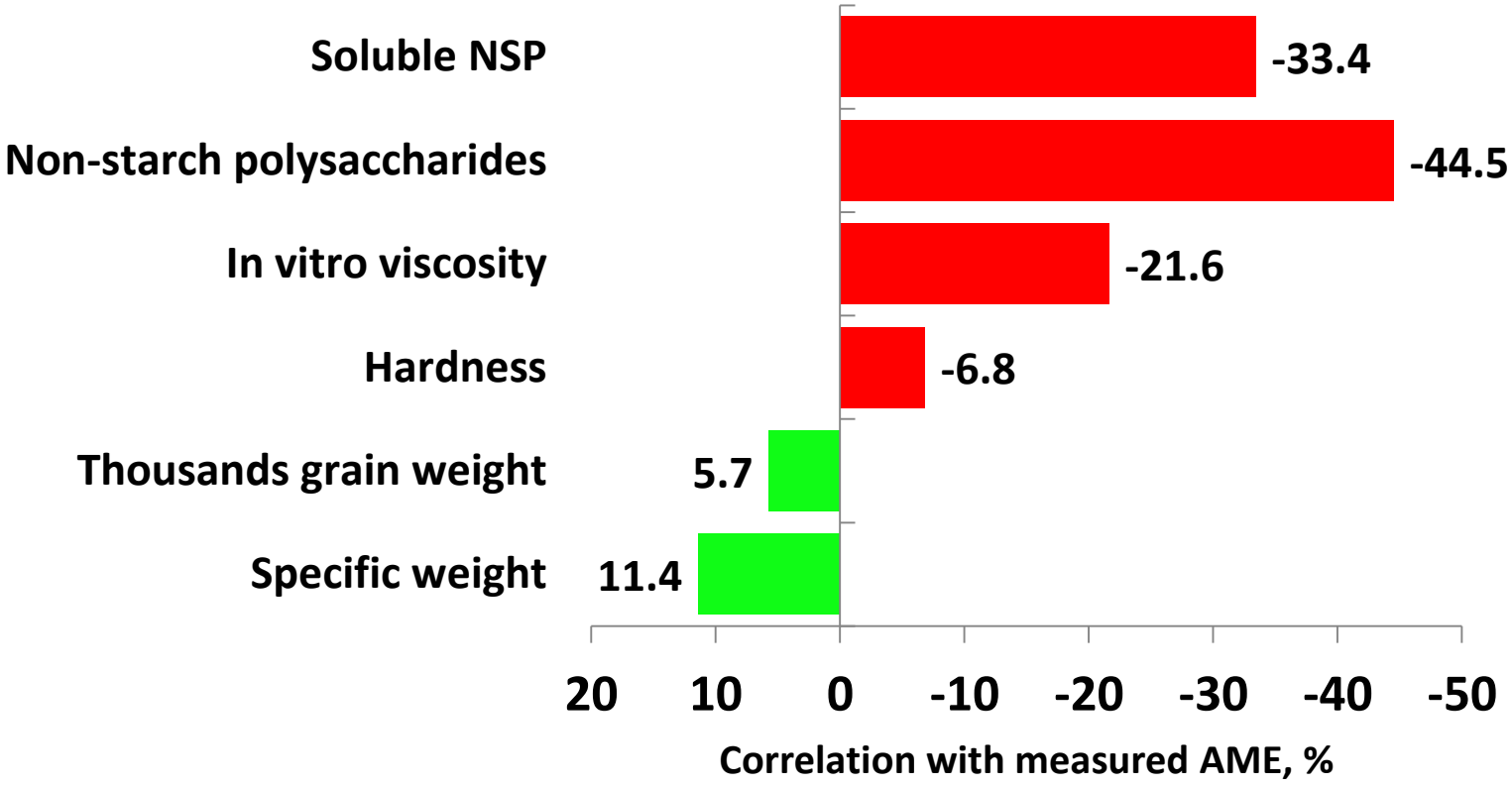
Austin et al. 1999. J. Cereal Sci. 29:77-88



Ball et al. (2013) Asian-Aust. J. Anim. Sci. 26:97-107

Measurable factors that impact the nutritive value of wheat

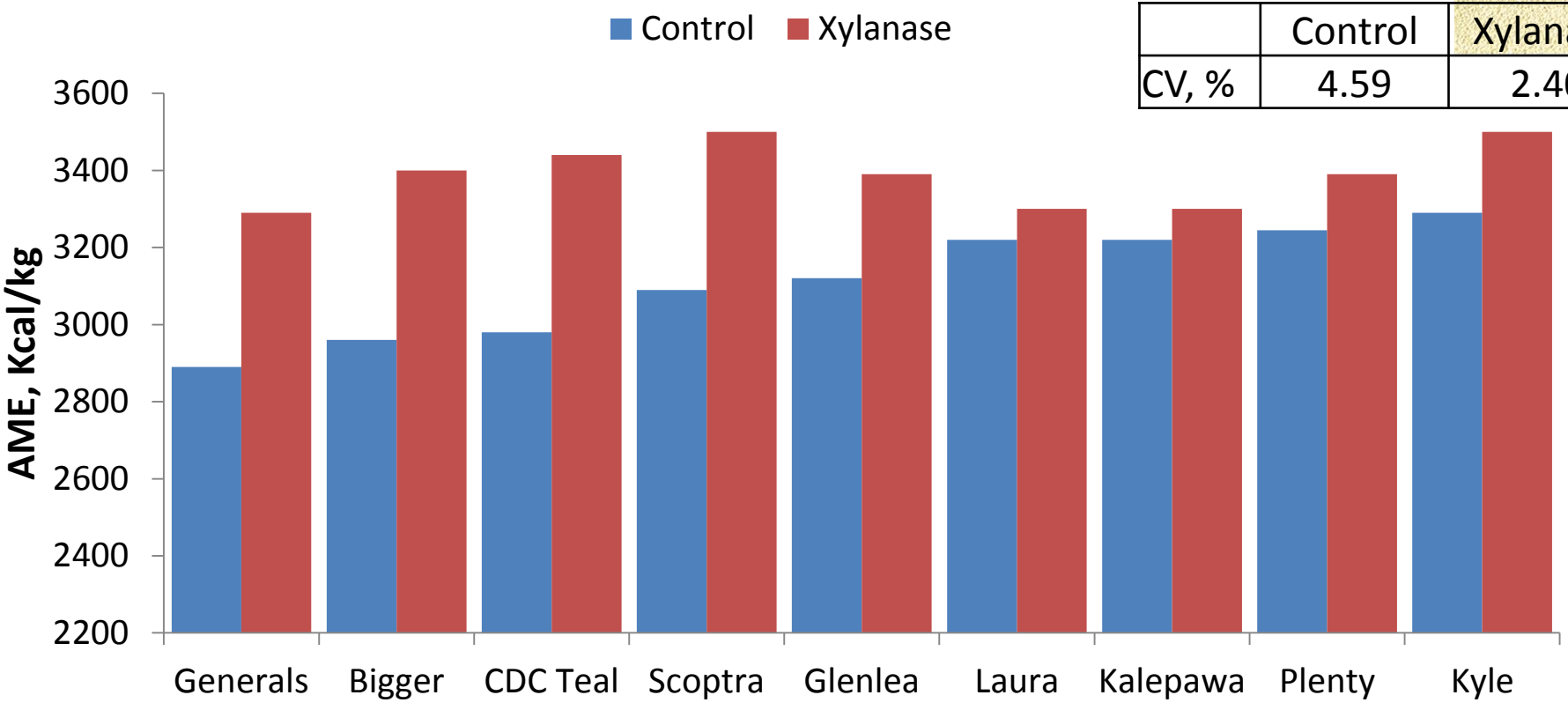
Correlation between measured AME in broilers and chemical/physical characteristics of 94 wheat samples



Ball et al. 2013. Asian-Aust. J. Anim. Sci. 26:97-107; Amerah, 2014 Anim. Feed Sci. Technol. 199: 1-9.

The value of Supplemental xylanase in improving the nutritive value of wheat for broilers is well proven

	Control	Xylanase
CV, %	4.59	2.40



- **High response in low AME wheat**
- **Reduce variability between wheat samples**

Bedford 1996. J. Appl. Poult. Res. 5: 370-378; Ravindran 2013. J. Appl. Poult. Res. 22 :628-636

PRACTICAL APPLICATIONS

Many factors (singly or interactively) have been suggested to influence the nutrients utilization & AME responses seen with supplemental xylanases in broilers

Enzymes

- Substrate specificity
- Microbial source
- Optimal Temp, pH
- Dosing
- Side activities
- Stability in feed
- Stability in the gut

Dietary

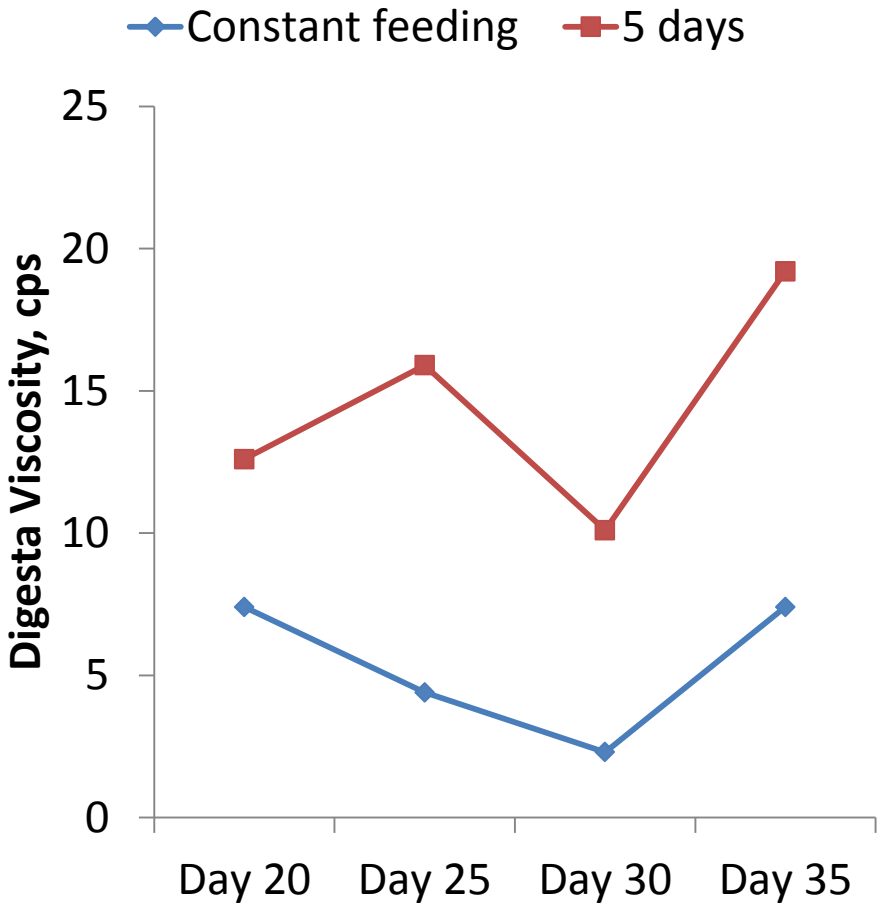
- Substrate level & matrix
- Substrate source
- Nutrients density
- Nutrients balance
- Fat, salt, antibiotics, other activities
- Diet form
- Particle size

Animal

- Age
- Sex
- Breed
- Microbial load
- Feed intake
- Husbandry
- Transit time
- pH transition

Bedford and Schulze, 1998 Nutr. Res. Rev. 11: 91; Adeola and Cowieson, 2011 J. Anim. Sci. 89: 3189; Slominski, 2011 PS 90: 2013; Ravindran 2013. J. Appl. Poult. Res. 22 :628-636

Jejunal and ileal digesta viscosity as influenced by age/ acclimatization to wheat test diets



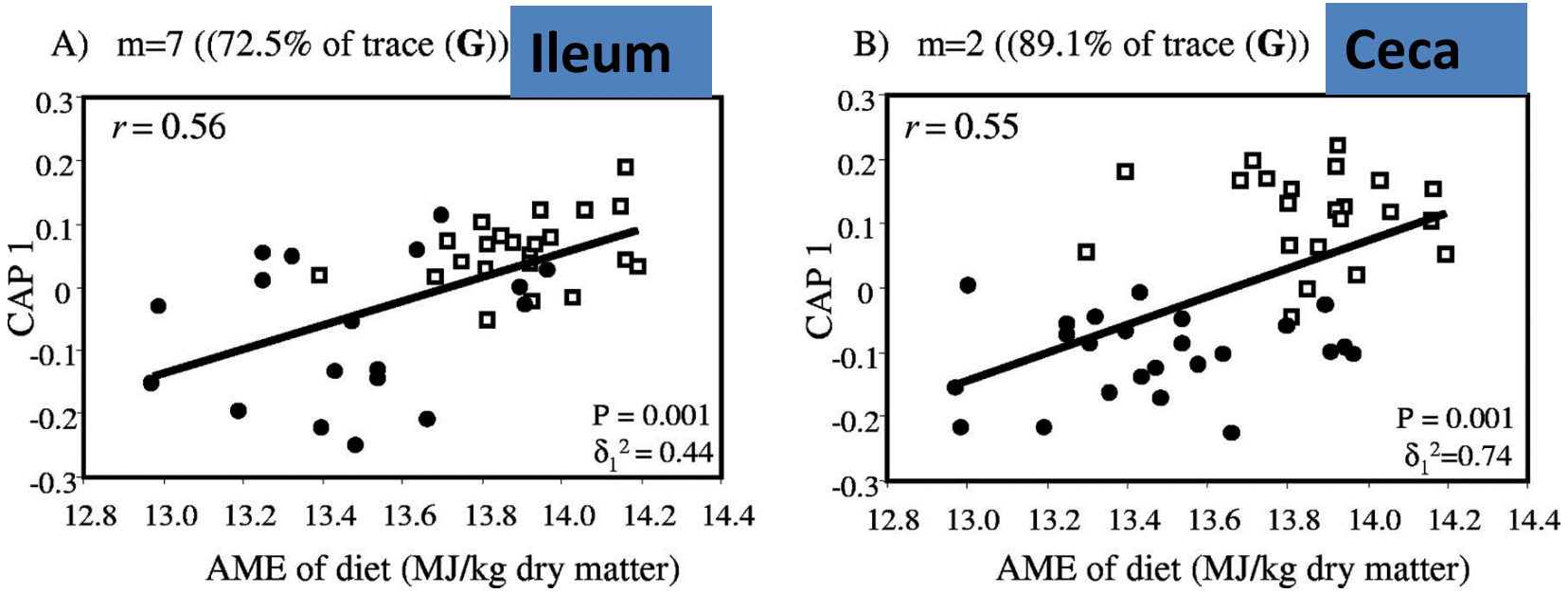
Protocols for measuring the efficacy of fiber degrading enzymes such as xylanase on the retention of fiber and nutrients rarely examine the impact of the duration of exposure to test diets

1. Constant feeding: test diets introduced at d 10 and fed throughout
2. 5days: commercial chick replaced by test diets 5 days before sampling

Petersen et al., 1999. Brit. Poult. Sci. 40:364-370.

Gut microbiota may have relevance in enzymes responses

Feed enzyme dietary energy uplift has been associated with certain clusters of gut microbial community….
implying that the presence of specific beneficial and/or absence of specific detrimental bacterial species is part of the improved performance seen with supplemental enzymes



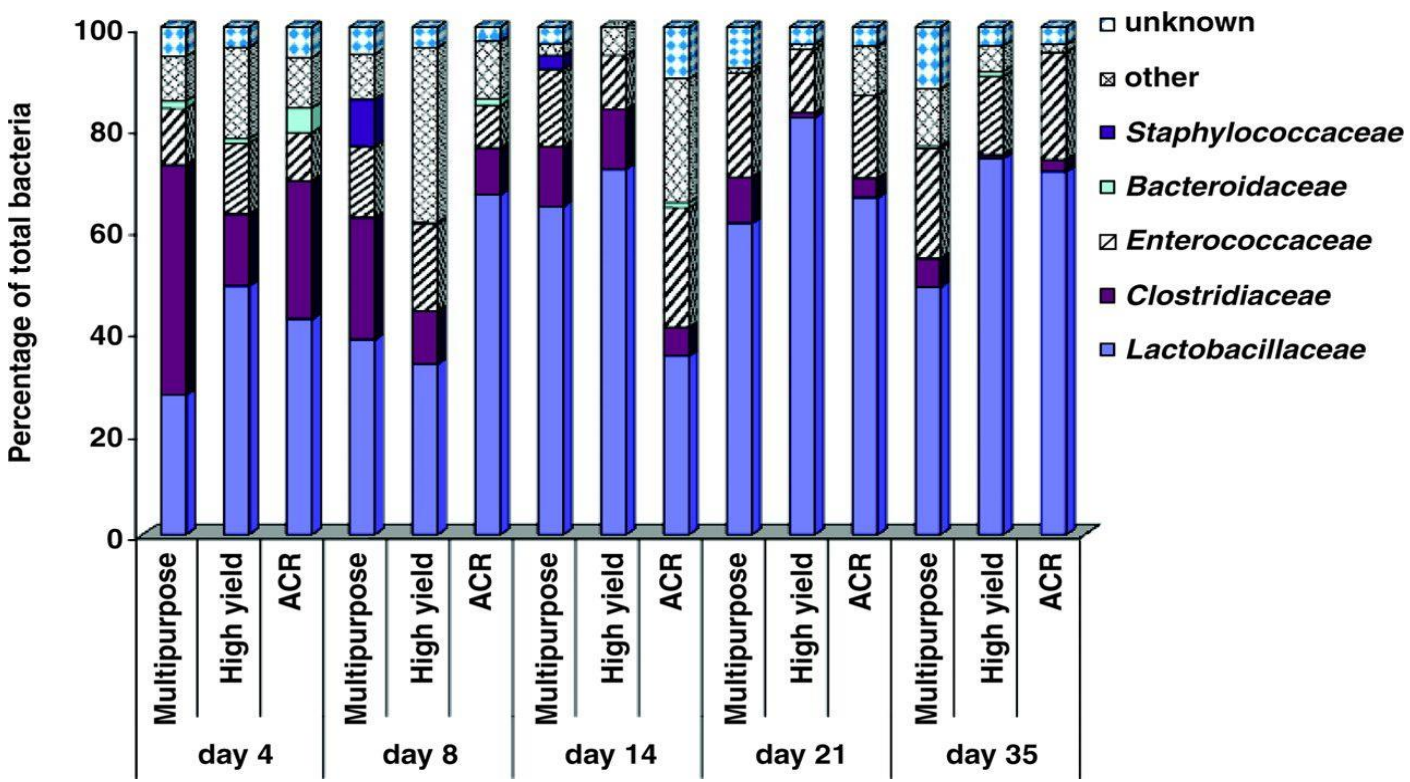
● Control, barley diet ▫ Control, plus feed enzyme

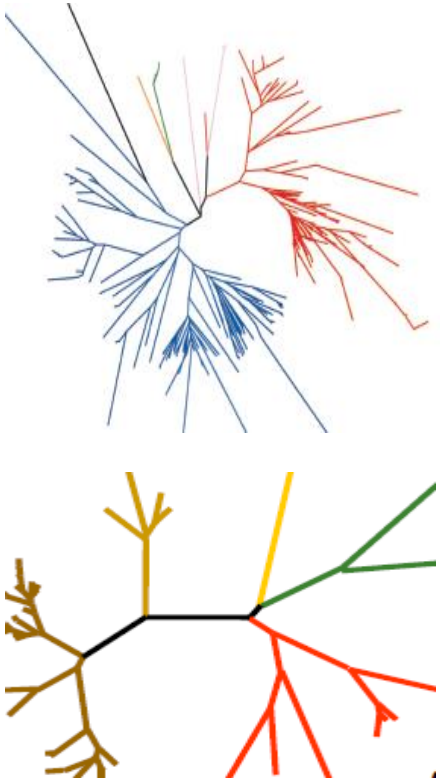
Torok V A et al. Appl. Environ. Microbiol. 2008;74:783-791

Furthermore gut is a Living Ecosystem

….Influenced by age and diet composition

Composition of ileal bacterial community of 3 genetic lines of broilers as determined by terminal restriction fragment length polymorphism analysis.





Lumpkins B S et al. Poultry Science 2010;89:1614-1621

Gaskins et al., 2002 AB 13: 29; Hill et al. 2002 AEM 68:3055; 2005 AEM 71:867; Klasing, 2007 BPS 8:525; Kiarie et al. 2013 Nutr. Res. Rev. 26: 71-88; Kiarie et al. Poult. Sci. 2014. 93: 1186-1196.

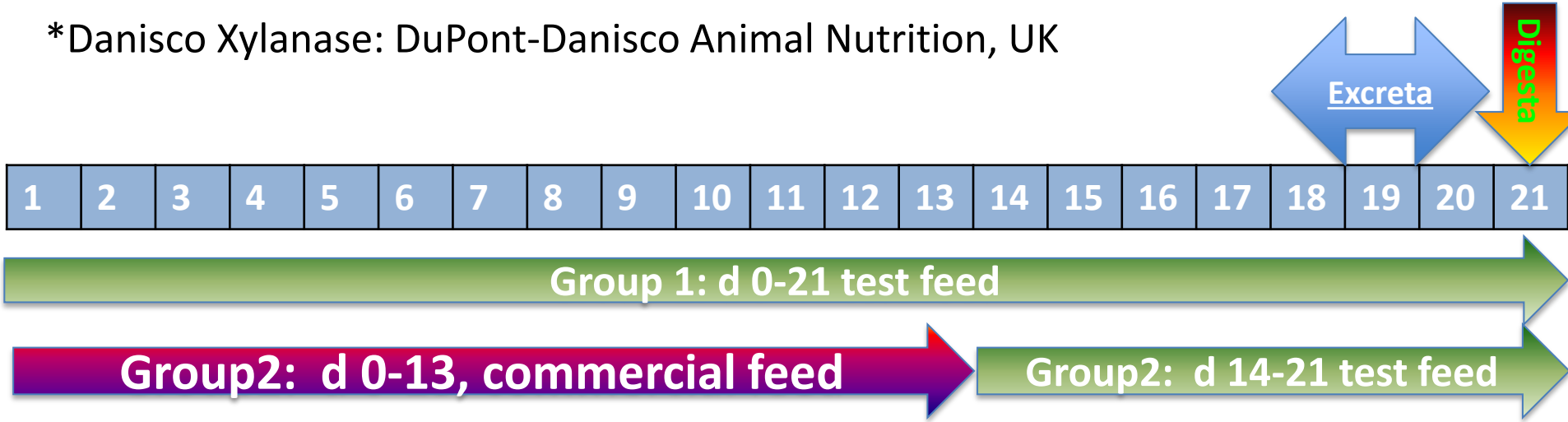
Objective

we evaluated the effects of exposing broilers to xylanase-supplemented diets for 7 or 21 d on fiber and nutrient retention at 21 d of age

MATERIALS AND METHODS

Treatments		
Exposure period	**Xylanase***	**U/kg of feed**
0-21	Control	0
0-21	Xyl1	2,500
0-21	Xyl2	5,000
14-21	Control	0
14-21	Xyl1	2,500
14-21	Xyl2	5,000

*Danisco Xylanase: DuPont-Danisco Animal Nutrition, UK



The experimental procedures were approved by the Massey University Animal Ethics Committee and, complied with the New Zealand Code of Practice for the Care and Use of Animals for Scientific Purposes

MATERIALS AND METHODS

Ingredient	%
Hard Wheat	49.78
Wheat Bran	5.00
Wheat middlings	5.00
Soybean Meal 44%CP	31.27
Animal Fat/AV blend	4.35
L-Lys/Met/Thr	0.35/0.29/0.26
Sodium Bica/salt	0.10/0.30
Limestone/MCP	1.51/0.49
Poultry Vits/TE's	1.00
Phytase*	0.01
Titanium dioxide	0.30
Calculated provisions	
ME, MJ/kg	11.65
CP, %	21.5
Dig Lys, %	1.19
Ca, %	0.88

Axtra® PHY is a *Buttiauxella spp.* phytase expressed in *T. reesei

Analyzed Composition, as fed	
Dry Matter, %	88.80
GE, MJ/kg	17.38
Crude protein, %	22.44
Fat, %	5.845
Ca, %	0.636
P, %	0.593
Carbohydrates, %	
Starch, %	36.45
NDF, %	11.82
ADF, %	3.69
Hemicellulose, %	8.13
Non-starch polysaccharides (NSP), %	
Soluble NSP	
Arabinose	0.66
Xylose	0.88
Total soluble NSP	2.78
Insoluble NSP	
Arabinose	1.93
Xylose	2.67
Total insoluble NSP	10.12
Total NSP	12.90

DuPont-Danisco Animal Nutrition, UK

MATERIALS AND METHODS

- A total of 384 male broiler (Ross 308) DOC
- 8 chicks per cage
  - Group 1 (d0-21), allocated diets based on d0 BW
  - Group 2 (d14-21), allocated diets based on d 14 BW
- The room temperature started at 31°C gradually reduced to 24 °C by d21.
- 20-hours of fluorescent illumination and free access to the diets and water
- Digestibility and retention determined using index method (TiO_2)

RESULTS: Performance parameters; d 14-21 (on Test feed)

		Day 14 to 21 performance, per bird			
	Exposure period	d 14 BW, g	BWG, g	Feed intake	FCR
Long Exposure	0-21 days	428b	382b	460b	1.202b
Short Exposure	14-21 days	456a	502a	694a	1.382a
	SEM	3.73	4.98	5.12	0.01
Xylanase	**Level, U/kg**				
Control	0	436	441	582	1.309a
Xylanase dose 1	2,500	447	442	578	1.297ab
Xylanase dose 2	5,000	444	444	569	1.271b
	SEM	4.57	6.10	6.27	0.01
Exp. Period	**Xylanase**				
Long Exposure	Control	419	378	460	1.219
Long Exposure	Xylanase dose 1	434	389	466	1.200
Long Exposure	Xylanase dose 2	432	381	453	1.189
Short Exposure	Control	452	504	705	1.399
Short Exposure	Xylanase dose 1	460	496	690	1.394
Short Exposure	Xylanase dose 2	456	507	686	1.353
	SEM	6.462	8.620	8.870	0.014
	Exposure period	<0.0001	<0.0001	<0.0001	<0.0001
	Xylanase	0.1908	0.9198	0.3401	0.0237
	Exp. * Xylanase	0.7097	0.4581	0.532	0.5662

RESULTS

There was no interaction (*P*>0.05) between exposure period and xylanase

Ileal Digesta

	Dry Matter	Nitrogen	Fat	Starch	Digestible energy
Exposure Period	0.0001	<0.0001	<0.0001	0.8939	0.0004
Xylanase	0.0008	<0.0001	0.0001	<0.0001	0.0008
Exp. Pd.*Xylanase	0.890	0.055	0.612	0.936	0.897

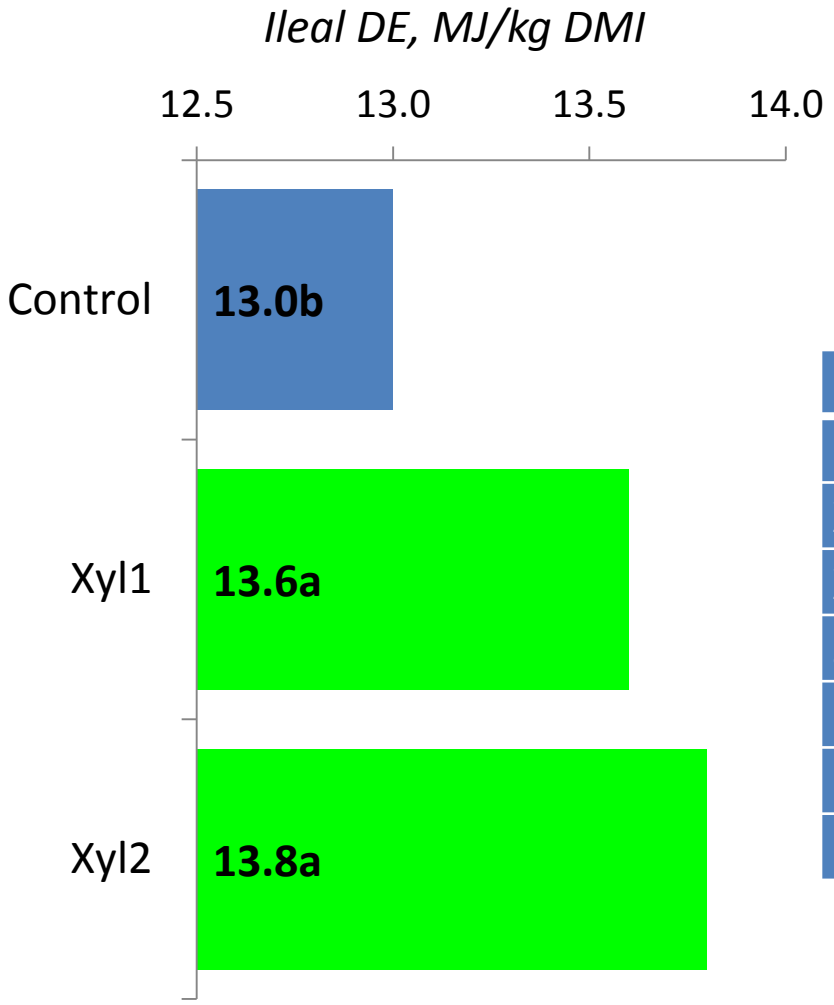
Excreta/Retention

	Dry matter	Fat	NDF	AMEn
Exposure Period	<0.0001	0.0238	0.0001	<0.0001
Xylanase	<0.0001	0.0007	<0.0001	<0.0001
Exp. Pd.*Xylanase	0.647	0.540	0.547	0.606

Values represent p-values

RESULTS: Effects of Xylanase on Ileal Digestibility

Xylanase linearly improved ileal nutrients and energy digestibility in broilers fed wheat based diets

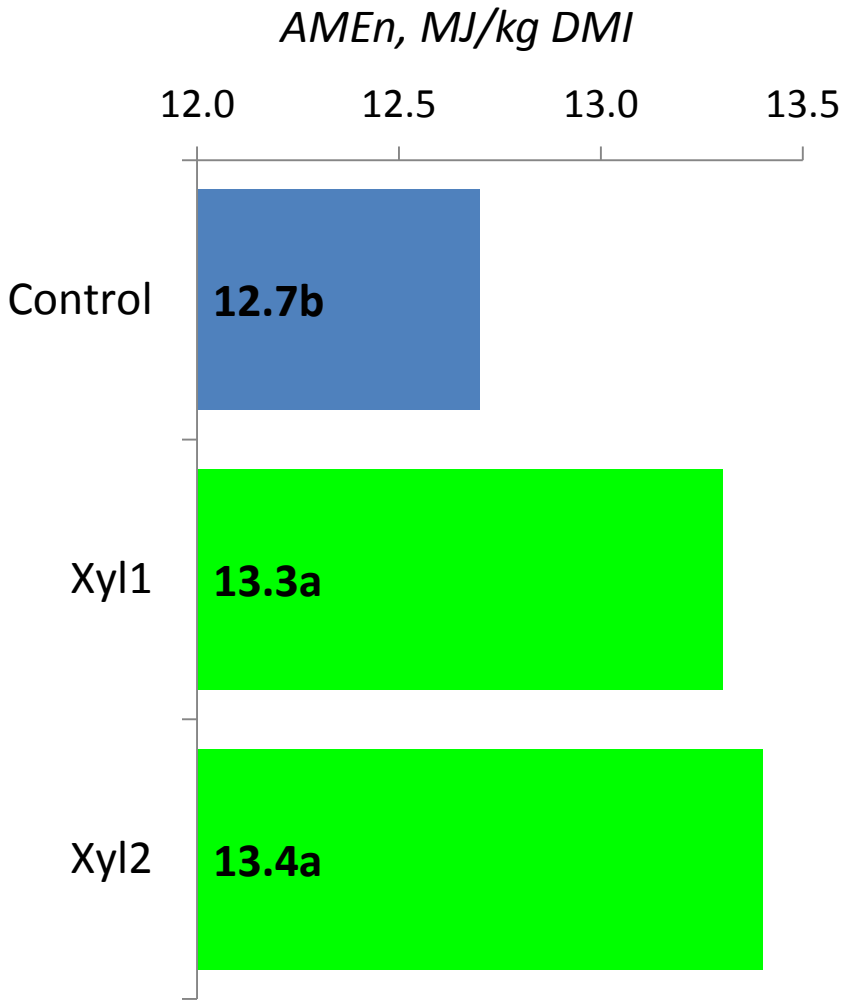


Treatment	U/kg of feed
Control	0
Xyl1	2500
Xyl2	5000

	DM	Nitrogen	Fat	Starch
Control	62.9b	79.1b	86.1b	93.4b
Xyl1	66.0a	82.5a	88.2a	97.7a
Xyl2	67.2a	83.0a	89.0a	98.1a
SEM	0.760	0.439	0.451	0.556
Contrasts				
Linear	0.0012	<0.0001	0.0052	<0.0001
Quadratic	0.3817	0.0583	0.4527	0.0041

RESULTS: Effects of Xylanase on Retention

Xylanase linearly improved nutrient retention and AMEn in broilers fed wheat based diets



SEM = 0.08

Treatment	U/kg of feed
Control	0
Xyl1	2500
Xyl2	5000

	DM	Fat	NDF
Control	574.6b	55.1b	19.6c
Xyl1	605.6a	57.1a	31.5b
Xyl2	616.9a	57.3a	36.2a
SEM	4.500	0.411	1.582
Contrasts			
Linear	<.0001	0.0007	<0.0001
Quadratic	0.1614	0.0961	0.1250

RESULTS: Effects of Exposure Period, ileal level

Shorter exposure to experimental diets resulted in higher apparent ileal nutrients digestibility

	Dry matter, %	Nitrogen, %	Fat, %	Starch, %	Digestible energy, MJ/kg
Day 14-21	67.2a	83.0a	89.9a	96.4	13.8a
Day 0-21	63.5b	80.0b	85.7b	96.4	13.2b
SEM	0.620	0.359	0.368	0.454	0.113

RESULTS: Effects of Exposure Period, at the excreta level

Longer exposure to experimental diets resulted in higher apparent components retention

	Dry matter, g/kg	Fat, g/kg	NDF, g/kg	AMEn, MJ/kg
Day 14-21	585.1b	56.0b	25.2b	12.9b
Day 0-21	612.9a	57.1a	33.0a	13.4a
SEM	3.674	0.335	1.291	0.062

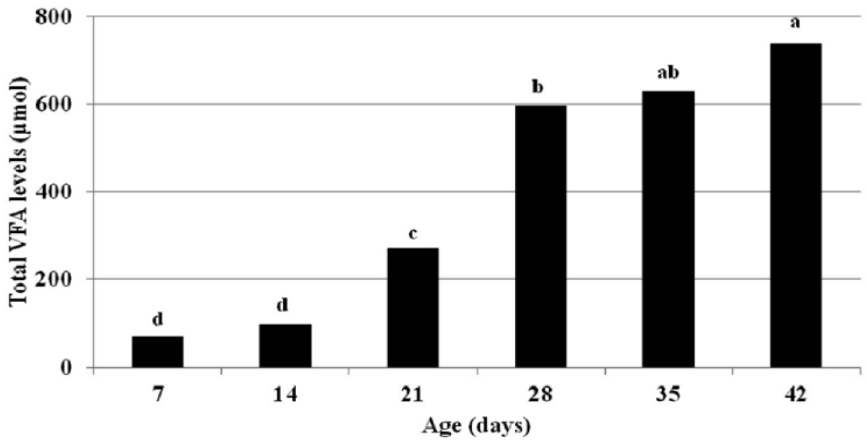


Figure 1 Effect of age on total volatile fatty acid levels in the caecum of broiler chickens (Fischer, 2003).

Longer exposure to the test diets may have resulted resulted in stabilization of fiber utilizing micro-organisms

Fisher, 2003, MSc. Thesis
University of Saskachewan

Summary and conclusions

- Independent of test diet exposure period:
  - Xylanase linearly improved nutrients and energy utilization in broilers fed wheat based diets
  - Xylanase responses on d 21 retention of fiber, nutrients and energy were independent of the test diets (7 or 21 d) exposure
- The data also showed that longer exposure resulted in more retained fiber suggesting possible microbial adaptation

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