EFFECT OF SUPPLEMENTAL MICROBIAL ENZYMES ON NUTRIENT DIGESTIBILITY AND GROSS RESPONSE OF BROILER CHICKENS FED DIETS CONTAINING HIGH-YIELDING TRITICALE

by A Widodo

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ABSTRACT

In a previous study, we showed that two new cultivars of triticale, Bogong and Canobolas, developed by a crop-breeding group at the University of New England, Australia, were superior to wheat in nutritive value for broiler chickens. In this follow-up study we investigated the benefits of further supplementation of diets containing these cultivars with xylanase and phytase (Econase XT and Quantum XT, AB Vista, UK), individually or in combination. The diets contained 65% triticale and were fed from hatch to 21 days of age. Data were analysed by the General Linear Model of Minitab. Feed intake to day 7 and 21d on supplemented Bogong diets (combined xylanase and phytase or Phytase alone) was higher (P<0.05) than on the control Bogong diet, while for the diets with Canobolas, xylanase and phytase ensured higher (P<0.05) feed intake than on the other Canobolas diets. Live weight at 7 and 21d on the diets was improved (P<0.05) by xylanase and phytase in combination or by phytase only. Feed conversion ratio was similar between the diets. The digestibility of crude protein, gross energy, starch, calcium and phosphorus on all enzyme-supplemented diets was improved by enzyme supplementation. There were no major differences between the cultivars. The results indicate a positive response to the tested enzyme supplements. Further studies will be conducted into the effects of these treatments on intestinal microbial profiles and digestive enzyme activities.

KEYWORDS: Bogong, Canobolas, Phytase, Xylanase.

INTRODUCTION

Two triticale cultivars developed by a breeding crop of University of New England, Australia, Bogong and Canobolas, are currently the best five high-yielding triticale varieties in some parts of Australia (Crouch & Saunders, 2009). In a previous study, we showed that the two new cultivars were superior to wheat in nutritive value for broiler chickens. It is also unlikely that the birds performed to their potential as the grains contain high levels of soluble non-starch polysaccharides, specifically xylans and arabinoxylans as well as phytate. The objective of this study was to investigate the response of broiler chickens on such diets based on these two cultivars when supplemented with microbial enzymes.

MATERIALS AND METHODS

Three hundred and eighty-four day-old male Ross 308 chicks were used in a 2x2x2 design study (2 cultivars of triticale,Bogong and Canobolas, with and without xylanase (Econase XT) and with and without phytase (Quantum XT). Both enzymes were supplied by AB Vista

Ltd, UK. The chicks were randomly allocated to the 8 diets in brooder cages in groups of 8 birds per cage. Each diet group was replicated six times.An indigestible marker (Titanium oxide) was included in the diets. The ingredient and nutrient compositions of the diets are shown in Table 1. Feed consumption and bird weight were measured on a weekly basis, and FCR was calculated. The diets were fed from hatch to 21 days. On day 21, three chicks from each cage were randomly selected and killed through cervical dislocation. The content of the ileum was collected for assessment of nutrient digestibility. All data collected were analysed using General Linear Model, Minitab.

RESULTS AND DISCUSSION

The gross response of the broiler chickens

Table 1 - Ingredient and nutrient composition (g/kg) of the diets fed.

Ingredients	BOG 0[1]	BOG X	BOG P	BOG XP	CAN 0	CAN X	CAN P	CAN XP
Bogong	650	650	650	650				
Canobolas					650	650	650	650
Soybean Meal	190	190	190	190	190	190	190	190
Soycomil K	69.4	69.4	69.4	69.4	61.3	61.2	61.2	61.2
L-Threonine	1.80	1.80	1.80	1.80	1.90	1.90	1.90	1.90
L-Lysine HCl	4.80	4.80	4.80	4.80	5.30	5.30	5.30	5.30
DL-Methionine	2.60	2.60	2.60	2.60	3.00	3.00	3.00	3.00
Sunflower oil	35.7	35.7	35.5	35.3	42.6	42.6	42.5	42.4
Limestone	18.1	18.1	18.1	18.1	18.1	18.1	18.1	18.1
Dical. P	13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8
Common Salt	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Choline Cl-70%	1.60	1.60	1.60	1.60	1.50	1.50	1.50	1.50
Phytase			0.20	0.20			0.20	0.20
Xylanase		0.10		0.10		0.10		0. 10
Premix[2]	2.60	2.60	2.60	2.60	2.50	2.50	2.50	2.50
TiO2	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Nutrient composition								
ME (MJ/kg)	12.7	12.7	12.7	12.7	12.9	12.9	12.9	12.9
Crude Protein	220	220	220	220	220	220	220	220
Crude Fat	53.8	53.7	53.6	53.5	59.4	59.3	59.2	59.1
Crude Fibre	25.5	25.5	25.5	25.5	25.2	25.2	25.2	25.2
Lysine	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
Methionine	6.10	6.10	6.10	6.10	6.50	6.50	6.50	6.50
Calcium	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1
Avail. P	5.20	5.20	5.20	5.20	5.60	5.60	5.60	5.60
Sodium	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Potassium	8.10	8.10	8.10	8.10	7.50	7.50	7.50	7.50
Chloride	5.60	5.60	5.60	5.60	3.40	3.40	3.40	3.40

1 - BOG 0, BOG X, BOG P and BOG XP are, respectively Bogong-based diets containing no enzymes; xylanase, phytase and combined enzymes. Diets containing Canobolas were similarly treated. 2 -Supplied per kg of diet (mg): vitamin A (as all-trans retinol): 3.6; cholecalciferol: 0.09; vitamin E (as d--tocopherol): 44.7, vitamin K3: 2; thiamine: 2; riboflavin: 6; pyridoxine hydrochloride: 5, vitamin B12: 0.2, biotin: 0.1, niacin: 50, D-calcium pantothenate:12, folic acid: 2, Mn: 80, Fe: 60, Cu: 8, I: 1, Co: 0.3, and Mo: 1.

is shown in Table 2. Feed intake to days 7 on diets containing either grain was significantly improved (P<0.01) by supplementation with phytase. Consumption 21d was affected by the inclusion of phytase (P<0.001) and the interaction of grain and of phytase (P<0.01) as well as interaction of between both enzymes (P<0.01). The combination of phytase and xylanase increased feed intake to 7dby 14.7 % on the Bogong-based diet while on the Canobolas diet the increase was about 15.9%. The influence of the phytase on feed intake to 21d, with the enzyme inclusion of increasing feed intake by 26.5 and 36.7%, respectively. The interactions between grain and phytase and also between xylanase and phytase were also significant (P<0.01). Live weight at 7 and 21d was significantly increased (P<0.001) by phytase on both grain diet groups. The FCR was not significantly affected by treatment factors although grain source tended (P<0.056) to increase feed intake to 7 days of age. The performances on these diets has confirmed the positive nutritive value of the triticale cultivars that were tested and the results agree with those of a previous study that assessed the replacement value of these grains for maize (Zarghi & Golian, 2009; Widodo, O'Neill, & Iji, 2011).

Xylanase inclusion (P<0.05) and phytase inclusion (P<0.001) resulted in an increase in the digestibility of crude protein (CP), energy, starch and phosphorus on diets based on either of the two grains (Table 3). The interactions between grain and xylanase were also significant (P<0.05) for crude protein and calcium digestibility and highly significantly (P<0.001) for P digestibility. Xylanase x grain interaction was also highly significant (P<0.001) for energy, starch and P digestibility and also significant for CP (P<0.01)

Table 2 - Response broiler chicken of feed intake (FI), live weight (LW) and feed conversion ratio (FCR) fed high-yielding triticale based-diet with and without enzymes[1].

Treatments		1-7 days			1-21 days		
Grain	Enzymes[2]	FI(g/bird)	LW (g/bird)	FCR(g/g)	FI (g/bird)	LW (g/bird)	FCR (g/g)
Bogong	-	146.3c	180.8cd	1.05	1008.7de	813.6b	1.31
Bogong	X	147.2c	182.8cd	1.04	1385.5a	826.6b	1.33
Bogong	P	167.5a	201.7a	1.04	1043.0d	1071.9a	1.35
Bogong	XP	164.6ab	198.3ab	1.05	1275.6c	1045.4a	1.27
Canobolas	-	147.4c	178.1d	1.08	954.9e	775.2b	1.31
Canobolas	X	154.1bc	189.1bc	1.04	1373.6ab	787.9b	1.29
Canobolas	P	168.3a	201.2a	1.05	961.1e	1066.0a	1.34
Canobolas	XP	170.8a	199.4a	1.08	1305.1bc	1048.4a	1.29
Pooled SEM[3]		1.94	1.79	0.005	27.0	20.2	0.010
Source of variation		**Significance of treatment effect[4]**					
Grain		ns	ns	0.056	ns	ns	ns
Xylanase		ns	ns	ns	ns	ns	ns
Phytase		***	***	ns	***	***	ns
Grain x Xylanase		ns	ns	ns	ns	ns	ns
Grain x Phytase		ns	ns	ns	**	ns	ns
Xylanase x Phytase		ns	0.082	ns	**	ns	ns
Grain x Xylanase x Phytase		ns	ns	ns	ns	ns	ns

1 - Each value represents the mean of 6 replicates; a, b, c, d, e values with unlike superscripts within each column are significantly different (P<0.05). 2 - Enzymes = - (Without enzymes), X = Xylanase, P = Phytase, XP = Xylanase and Phytase. 3 - SEM = Standard error of mean. 4 - Significance of treatment effect: ns = not significant; * = P<0.05; ** = P<0.01; *** = P<0.001.

Table 3 - Crude protein, Gross energy, Starch, Calcium and Phosphorus digestibility (%) of broiler chicken on day 21 fed high-yielding triticale based-diet with and without enzymes[1].

Treatments		**Crude Protein**	**Gross Energy**	**Starch**	**Calcium**	**Phosphorus**
Grain	**Enzymes[2]**					
Bogong	-	77.68c	78.93d	83.49c	41.32b	43.77d
Bogong	X	80.99b	81.63c	86.30ab	46.44ab	72.49bc
Bogong	P	84.97a	84.03ab	86.79ab	45.75ab	77.56a
Bogong	XP	82.15ab	82.89abc	85.56b	44.14ab	77.18a
Canobolas	-	75.79c	77.03e	82.99c	32.18c	71.39c
Canobolas	X	81.18b	82.14c	85.77ab	50.60a	77.70a
Canobolas	P	81.34b	84.64ab	87.17a	41.15b	76.29ab
Canobolas	XP	84.48a	82.56bc	85.86ab	47.98ab	77.12a
Pooled SEM[3]	0.549	0.405	0.261	1.210	3.590	
Source of variation			**Significance of treatment effect[4]**			
Grain	ns	ns	ns	ns	***	
Xylanase	*	*	*	**	***	
Phytase	***	***	***	ns	***	
Grain x Xylanase	*	ns	ns	*	***	
Grain x Phytase	ns	ns	ns	ns	***	
Xylanase x Phytase	**	***	***	*	***	
Grain x Xylanase x Phytase	ns	ns	ns	ns	***	

1 Each value represents the mean of 6 replicates; a, b, c, d, e values with unlike superscripts within each column are significantly different (P<0.05); 2 - Enzymes = - (Without enzymes), X = Xylanase, P = Phytase, XP = Xylanase and Phytase. 3 - SEM = Standard error of mean. 4 - Significance of treatment effect: ns = not significant; * = P<0.05; ** = P<0.01; *** = P<0.001

and Ca (P<0.05). The three-way interactions between grain, xylanase and phytase was not significant except for P digestibility (P<0.001). The greater effect of the enzymes, particularly, phytase supports the findings of previous researchers, for example Ravindran *et al*.(1999; 2000) and Kornegay (2001). The two enzymes have wide-ranging effects on the digestibility of different nutrients and also energy, which would explain the improvement in gross response that was observed in this study.

CONCLUSION

The two enzymes that were tested in this study had a pronounced effect on the nutritive value of the diets. It is possible to achieve higher productivity on diets based on the tested triticale cultivars through supplementation with these enzymes.

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