Animal Nutrition 2 (2016) 173–179

Contents lists available at ScienceDirect

Animal Nutrition

journal homepage: http://www.keaipublishing.com/en/journals/aninu/

Original research article

Evaluation of the effect of different wheats and xylanase supplementation on performance, nutrient and energy utilisation in broiler chicks

Gemma González-Ortiz [a], Oluyinka Olukosi [b], Michael R. Bedford [a, *]

[a] AB Vista, Marlborough, Wiltshire SN8 4AN, United Kingdom
[b] Monogastric Science Research Centre, Scotland's Rural College, Edinburgh EH9 3JG, United Kingdom

ARTICLE INFO

Article history:
Received 12 March 2016
Received in revised form
24 June 2016
Accepted 27 June 2016
Available online 1 July 2016

Keywords:
Wheat
Near-infrared spectroscopy
Xylanase
Nutrient release
Energy
Broiler chickens

ABSTRACT

The aim of this study was to evaluate the performance, nutrient utilisation and energy metabolism of broiler chicks fed 8 different wheat samples, supplemented or not with xylanase. Seven-hundred sixty eight male broilers (1-day-old) were distributed to 16 experimental treatments (6 replicates per treatment). The treatments were in a factorial arrangement with 8 different wheats and 2 levels of xylanase (0 or 16,000 BXU/kg). The predicted apparent metabolisable energy (AME) of the wheat samples ranged from 13.0 to 13.9 MJ/kg and all diets were formulated to contain the same amount of wheat. Body weight gain (BWG) and feed intake (FI) were measured at 21 d, as was jejunal digesta viscosity, and feed conversion ratio (FCR) calculated. On day 24, one representative bird per pen was selected to calculate whole body energetics. At 21 d, 3 chicks per replicate were randomly allocated to metabolism cages for energy and nutrient utilisation determinations, and were continued on the experimental diets until 24-d-old. No interactions were observed for any performance response variables, ileal nutrient utilisation or digesta viscosity. Xylanase improved BWG and reduced FCR and digesta viscosity ($P < 0.05$). Wheat influenced dry matter (DM) utilisation and xylanase increased ileal digestible energy ($P = 0.04$). Xylanase also improved ($P < 0.05$) DM and nitrogen retention. Apparent metabolisable energy and AME corrected for nitrogen (AMEn) were subject to an interaction whereby wheats 2 and 6, which returned the lowest AME and AMEn values, responded to xylanase supplementation and the remainder did not. Net energy for production and the efficiency of energy use for production were not influenced by xylanase, but were affected by wheat ($P < 0.05$). Despite the significant differences between wheats with regards to their nutrient utilisation and energy metabolism in birds, xylanase removed this variance and resulted in more homogeneous performance.

1. Introduction

Variation in the nutritive value of wheat samples is a reflection of genetic and environmental effects, and the economic impact of these variations on poultry performance highlights the need for improved predictors of wheat quality (Yegani and Korver, 2012). This is a concern for plant breeders, farmers and animal nutritionists. Thus, nutritionists need to know the nutritional requirements of commercial poultry, and be able to determine or predict the nutritive value of each batch of raw material in an accurate and timely manner (van Kempen and Simmins, 1997).

The use of near-infrared spectroscopy (NIRS) provides an opportunity to determine the chemical composition of feedstuffs and their nutritive values before inclusion in the diet (Olukosi et al., 2011; Owens et al., 2009). The information from NIRS can be used to reduce or minimize nutrient imbalances in commercial rations fed to the animals. However, there are potential errors associated

* Corresponding author.
E-mail address: mike.bedford@abvista.com (M.R. Bedford).
Peer review under responsibility of Chinese Association of Animal Science and Veterinary Medicine.

Production and Hosting by Elsevier on behalf of KeAi

http://dx.doi.org/10.1016/j.aninu.2016.06.005

with NIRS technology such as sample-related and chosen reference method errors which can lead to high values for coefficient of variation (Yegani and Korver, 2012), and as a result care must be taken in establishing NIRS calibration to ensure it is robust, precise and accurate. Near-infrared spectroscopy calibrations now exist which can predict non-starch polysaccharide (NSP) and energy contents of wheat. In particular xylans are often considered an anti-nutrient in wheat, and as a result variation in content of this component between wheat samples may contribute to differences in nutritive value. Xylanases are the major enzymes involved in arabinoxylan degradation, hydrolysing the 1,4-β-D-xylosidic linkage between xylose residues in the backbone in a random manner (Mendis et al., 2016). Therefore it is hypothesised that their supplementation in poultry feed may balance animal performance although differences in the nutritive value of different wheat origins. This work was undertaken to determine if such a calibration by NIRS accurately predicts animal performance, and if so whether the application of an NSP-degrading xylanase would reduce the performance differences between samples of wheat which differ in NSP content (Bedford, 2000).

2. Materials and methods

All the experimental procedures received prior approval from the Scotland's Rural College's Animal Experiment Committee.

2.1. Birds and experimental design

A total of 768 one-day old male broiler chicks (Ross 308) obtained from a commercial hatchery were used in the study for 2 experiments to determine growth performance and whole-body energy metabolism (Exp. 1) and nutrient utilisation (Exp. 2) responses. For Exp. 1 ($n = 768$) and for Exp. 2 ($n = 288$), birds were allocated to 16 experimental treatments in a randomized complete block design with an 8 × 2 factorial arrangements of treatments (8 wheat samples and 2 levels of xylanase), having in both experiments 6 replicates per treatment. Throughout the study, feed and water were supplied *ad libitum* and animals were raised under controlled conditions of light and temperature, as breeder recommended.

2.1.1. Experiment 1

Birds were reared up to day 24 in floor pens. All broiler chickens and feed were weighed on days 0 and 21 to calculate growth performance responses: body weight gain (BWG), feed intake (FI) and feed conversion ratio (FCR). On day 21, 2 chickens were randomly selected and euthanized by an overdose of sodium pentobarbital and jejunal digesta were collected for viscosity measurement. On day 24, 1 representative bird (on BW basis) per floor pen was selected and fasted prior to euthanasia to calculate whole body energetics.

2.1.2. Experiment 2

On day 21, 3 chicks were randomly selected from each of the 96 floor pens and transferred to 96 metabolism cages (for energy and nutrient utilisation trial) where chickens continued to receive the corresponding diets until 24 days of age. Excreta and ileal digesta were collected on day 24 and pooled on a cage basis for calculation of nutrient utilisation.

2.2. Diets and wheat selection

Starter experimental diets based on wheat and soybean-meal were formulated to be marginally lower in metabolizable energy (ME) than Ross 208 requirements (Table 1). Eight wheat samples originating from Germany and United Kingdom were obtained. Dry matter (DM), gross energy (GE), fat, nitrogen (N), calcium (Ca) and the phosphorous (P) contents of wheat samples were chemically analysed and further NIRS analyses were performed (Tables 2 and 3). A fixed amount of each wheat (58.6%) was used in the formula regardless of their chemical composition. Diets were predicted to contain 12.8 ME MJ/kg based on assumed average wheat apparent ME (AME) 58.6% came from wheat grain. Control diets were supplemented with 16,000 BXU/kg of xylanase following

Table 1
Ingredient and calculated composition as-fed of the experimental diets.

Item	Control	+ Xylanase
Ingredient, g/kg		
Wheat – feed	585	585
Soybean meal 48	325	325
Soy oil	44.4	44.4
NaCl	3.00	3.00
Sodium bicarbonate	1.87	1.87
DL-methionine	2.99	2.99
Lysine HCl	2.46	2.46
Threonine	0.77	0.77
Limestone	7.86	7.86
Dicalcium phosphate	15.5	15.5
Vitamin premix[1]	4.90	4.90
Phytase[2]	+	+
Xylanase[3]	–	+
Calculated nutrient composition, %		
Crude protein	22.4	22.4
Ca	0.90	0.90
P	0.74	0.74
Available phosphorous	0.45	0.45
Fat	5.72	5.72
Fibre	2.55	2.55
Met	0.62	0.62
Cys	0.38	0.38
Met + Cys	1.00	1.00
Lys	1.35	1.35
His	0.55	0.55
Trp	0.28	0.28
Thr	0.88	0.88
Arg	1.45	1.45
Ile	0.92	0.92
Leu	1.64	1.64
Phe	1.05	1.05
Val	1.00	1.00
AME, MJ/kg	12.8	12.8

AME = apparent metabolisable energy.
[1] Vitamin/mineral premix supply per kilogram of diet: vitamin A, 16,000 IU; vitamin D_3, 3000 IU; vitamin E, 25 IU; vitamin B_1, 3 mg; vitamin B_2, 10 mg; vitamin B_6, 3 mg; vitamin B_{12}, 15 μg; nicotinic acid, 60 mg; pantothenic acid, 14.7 mg; folic acid, 1.5 mg; biotin, 125 μg; choline chloride, 25 mg; Fe as iron sulphate, 20 mg; Cu as copper sulphate, 10 mg; Mn as manganous oxide, 100 mg; Co as cobalt oxide, 1.0 mg; Zn as zinc oxide, 82.222 mg; I as potassium iodide, 1 mg; Se as sodium selenite, 0.2 mg; and Mo as molybdenum oxide, 0.5 mg.
[2] Quantum Blue 5G, AB Vista, Marlborough, UK; 5000 FTU/g.
[3] Econase XT 25P, AB Vista, Marlborough, UK; 160,000 BXU/g.

Table 2
Analysed nutrient composition and coefficient of variation (CV) of the wheat samples.

Item	Wheat samples								CV
	1	2	3	4	5	6	7	8	
Gross energy, MJ/kg	18.0	18.1	18.1	18.0	18.2	17.9	18.0	18.1	<1
Viscosity, cP	10.5	8.50	12.8	13.0	11.3	11.2	7.60	7.80	21
Dry matter, %	87.2	87.4	87.8	87.5	87.1	87.2	88.6	87.6	<1
Fat, %	1.49	1.37	1.48	1.37	1.26	1.15	1.24	1.94	17
Nitrogen, %	2.22	1.88	2.37	2.10	2.02	1.79	1.55	1.79	13
Calcium, %	0.03	0.03	0.03	0.03	0.03	0.02	0.02	0.05	31
Phosphorous, %	0.28	0.32	0.34	0.33	0.38	0.29	0.27	0.33	11
Phytic acid, %	0.75	0.77	0.64	0.72	0.81	0.92	0.53	0.53	19