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Original Research

Effect of a by-product of solid state fermentation (Synergen™) on broiler performance

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Summary

The trial was conducted to evaluate the effect of a by-product of solid state fermentation (Synergen™ (SGN), Alltech Inc, Nicholasville KY, USA) on broiler performance and health. One thousand two hundred and eighty male Ross 308 broilers were used in a 42 day pen trial. The trial was designed as a 2 × 2 factorial, with two diet specifications (standard and reformulated) plus or minus SGN (0 and 200 g/t, SGN replaced with commercial enzyme Ronozyme™ at 150 g/t) to give four dietary treatments in total in a corn-soy based diet formulated to commercial standards. Birds fed the reduced energy diets had significantly lower cumulative feed intakes at 42 d ($P < 0.01$) compared to those on the full specification standard diet. There were no significant differences in broiler body weight due to treatments at any age. Significant improvements ($P < 0.05$) in FCR, primarily due to SGN inclusion in the feed, were observed for all weekly reported data. There were no significant differences in either mortality or EPEF for any of the treatment diets. The present study indicates that SGN, a by-product of solid state fermentation (SSF) can improve feed conversion of broilers fed a corn-soy diet.

Keywords: Synergen: by-product: solid state fermentation: broiler: performance

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Introduction

To improve sustainability, poultry operations must work towards improving feed digestibility and feed efficiency. High diet digestibility not only enhances the amount of absorbed nutrients and reduces nutrient excretion, but will also reduce the flow of nutrients to the lower digestive tract and impact the intestinal microflora. In particular, a decreased flow of undigested protein to the hind gut has been shown to improve the gut environment and to reduce the proliferation of potential pathogens such as *Clostridium perfringens* (Drew *et al*., 2004).

Many different factors, such as diet composition (NRC, 1994), quality of ingredients, processing and enzyme inclusion, can affect diet digestibility. Grinding (particle size) and thermal treatment are two key issues in the feed manufacturing process that can impact nutrient utilisation. Pelleting and other thermal treatments can improve diet digestibility (Zelenka, 2003; Ferket *et al*., 2002). Particle size and overall feed structure is another factor to consider (Amerah *et al*., 2007), as research has shown beneficial effects of whole wheat feeding on diet digestibility and production efficiency in broilers. The use of whole wheat has been demonstrated to increase gizzard weight, and feeding 10% to 20% whole wheat can increase ME and amino acid digestibility (Biggs and Parsons, 2009). In the last twenty years or so, much effort has been made to improve the nutritive value of feedstuffs by using exogenous enzymes. Numerous authors have established that, through enzyme addition, the performances can be improved by up to 10% (Cowieson *et al*., 2000), whereas in some studies no positive effect was reported (McNab and Bernard, 1997; Perić *et al*., 2002). The effect of enzymes depends on the composition and quality of the feed,

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dosing rate and type of enzyme, as well as environmental conditions (Acamovic, 2001; Lukić *et al.*, 2002). Some researchers indicate that greater effects can be realised with a combination of two or more enzymes (Chesson, 2001; Kim *et al.*, 2005). Microbial phytase is commonly added to feed in order to improve P digestibility and utilisation, reducing P excretion into the environment (Angel *et al.*, 2006; Leytem *et al.*, 2008). Moreover, some researchers have reported positive effects of microbial phytase on the nutritional value of plant-based diets, by enhancing protein digestibility and improving digestive health and immunity (Kies *et al.*, 2001; Choct, 2006). Furthermore, other technical feed additives which influence the intestinal microflora have been shown to improve diet digestibility. The benefits seem more pronounced in situations with some microbial challenge.

Synergen™ (SGN; Alltech Inc, Nicholasville KY, USA) offers a novel approach to improve diet digestibility and bird performance. It is a by-product of a process known as 'Solid State Fermentation' (SSF) using *Aspergillus niger* that contains residual enzyme activity (registered in the EU under regulation 767/2009 in the Catalogue of Feed Materials). The SSF process involves the selection of specific strains of naturally occurring fungi which have the ability to modify the nutrient profiles in a wide range of feed by-products, including corncob, wheat bran, soybean meal and palm kernel meal. These products can then be used in diet reformulation as digestive enhancers. SGN allows for a more flexible approach to feed formulation through the inclusion of by-products or by decreasing the nutrient constraints in the diet (Murphy *et al.*, 2009). Currently only few publications exist regarding the use and benefits of SGN in poultry diets. However, the available reports have shown significant improvements in performance through increases in weight gain and egg production and better feed conversion ratio (Murphy *et al.*, 2009; Nollet *et al.*, 2011 and Peric *et al.*, 2013). This study was undertaken to evaluate the effect of a by-product of SSF on broiler performance and health.

Materials and methods

One thousand two hundred and eighty male Ross 308 broilers from one breeder flock were used in a 42 day feeding study. The birds were split into four treatment groups and housed from day old in floor pens measuring 2.6 m^2; to give eight replicate pens of 40 broilers per treatment. Pens were deep littered with chopped wheat straw, and feed and water were supplied *ad libitum*. The trial was designed as a 2 × 2 factorial, with two diet specifications (standard and reformulated) plus or minus SGN (0 and 200 g/t) to give four dietary treatments in total. The four treatments used in the study were as follows: diet 1: Basal control diet, with Ca and available P reduced by 0.1% plus 200 g/t SGN; diet 2: as for diet 1 but using a commercial phytase (Ronozyme NP DSM) at a dose of 150 g/t; diet 3: reformulated diet (as for diet 1 but with 75 kcal reduction in ME) plus 200 g/t SGN; diet 4: as for diet 3 but with a commercial phytase (Ronozyme NP DSM) at a dose of 150 g/t

Table 1. Feed composition and nutrient specifications

	Standard specification			Reduced specification		
	Starter	Grower	Finisher	Starter	Grower	Finisher
Ingredients (%)						
Corn	49.32	54.38	60.38	50.85	55.91	61.90
Soybean meal (44% CP)	23.04	13.97	9.45	27.61	18.54	14.03
Full fat soya	23.18	27.68	26.47	17.05	21.56	20.35
Monocalcium phosphate	1.17	0.99	0.92	1.18	1.01	0.94
Limestone	1.60	1.33	1.27	1.60	1.32	1.27
Salt	0.35	0.35	0.36	0.35	0.35	0.35
DL-Methionine	0.17	0.11	0.15	0.18	0.12	0.15
L-Lysine	0.17	0.19	–	0.17	0.19	–
Premix	1.00	1.00	1.00	1.00	1.00	1.00
Chemical composition						
Crude protein (%)	23.00	21.00	19.00	23.00	21.00	19.00
ME (MJ/kg)	12.65	13.20	13.40	12.34	12.89	13.09
Lysine (%)	1.43	1.24	1.01	1.43	1.24	1.01
Meth + Cys (%)	0.92	0.88	0.80	0.92	0.88	0.80
Calcium	0.95	0.80	0.75	0.95	0.80	0.75
Total P	0.66	0.61	0.57	0.67	0.61	0.58
Available P	0.42	0.37	0.34	0.42	0.37	0.34

Table 2. Cumulative weekly feed consumption for broilers fed either a standard or reduced specification diet with two types of commercial digestive enhancers

Aged	Standard specification diet		Reduced specification		SEM	P value		
	SGN	Phytase	SGN	Phytase		Feed	Digestive Enhancer	F × DE
7	176	184	184	182	0.002	0.468	0.436	0.254
14	548	555	546	549	0.004	0.625	0.479	0.803
21	1237	1260	1222	1253	0.006	0.403	0.045	0.772
28	2200	2249	2174	2228	0.011	0.046	0.032	0.925
35	3496	3521	3417	3517	0.019	0.340	0.546	0.622
42	4927[a]	5028[b]	4838[c]	4939[ac]	0.019	<0.01	<0.01	0.756

[a-c] Values within the rows with no common superscript are significantly different ($P < 0.05$)

instead of SGN. Broilers were fed three phases of diets, starter from 0-14 d, grower from 15-35 d, and finisher 36-42 d. The basal diets for all three phases were corn-soy based and formulated to commercial standards to meet current NRC recommendations (NRC, 1994; Table 1).

Body weights per pen were measured and recorded on days 1, 14, 21, 28 and 35. On day 42 (the end of the trial) birds were weighed individually. Feed intakes were recorded and feed conversion ratios calculated weekly as well as for the overall trial period. FCR was calculated from the feed intake and weight gain data both weekly and over the whole trial period. Mortality and culling was recorded on a daily basis, and all performance parameters were used to calculate the European Production Efficiency Factor (EPEF) according to the equation:

$$\frac{\text{Body weight (g)} \times \text{survival rate(\%)} \times 10}{\text{FCR} \times \text{duration of trial (days)}}$$

All procedures were conducted according to ethical norms proposed by the European Convention for the Protection of Vertebrate Animals Used for Experimental and Other Scientific Purposes, confirmed by Serbian authorities (Službeni glasnik RS-Medjunarodni ugovori, 1/2010).

Data were analysed by ANOVA using the GLM procedure and means separated by Duncans *post hoc* test using StatSoft computer package (STATISTICA 10, 2011), using 5% confidence limits, with pen as the experimental unit.

Results

Birds fed the reduced energy diets had significantly lower cumulative feed intakes at 28 d ($P < 0.05$) and 42 d ($P < 0.01$) compared to those on the full specification standard diet (Table 2). There was a significant impact of feeding SGN at 21 d ($P < 0.05$), 28 d ($P < 0.05$) and 42 d ($P < 0.01$), whereby the commercial phytase-fed birds had higher intakes. However, no significant interactions were observed between the two factorial treatments.

There were no significant differences due to treatments at any age for broiler body weight (Table 3). However there was a strong trend ($P = 0.063$) for a reduction in body weight at 21 d for birds fed the reduced energy diets, irrespective of SGN or Ronozyme use.

Significant improvements ($P < 0.05$) in FCR, primarily due to SGN inclusion in the feed, were observed for all weekly reported data, excluding d 14 (Table 4). This was strongly significant after 21 d ($P < 0.01$). At 42 d, there was a significant impact observed due to feed specification, with birds fed the reduced energy diet having better FCRs

Table 3. Body weights of broilers fed a standard or reduced energy diet supplemented with two types of commercial digestive enhancer

Aged	Standard specification diet		Reduced specification		SEM	P value		
	SGN	Phytase	SGN	Phytase		Feed	Digestive Enhancer	F × DE
1	42.7	42.7	43.1	43.1	–	–	–	–
7	201	198	201	199	0.927	0.717	0.184	0.717
14	430	423	423	422	2.718	0.559	0.457	0.612
21	921	912	898	903	4.231	0.063	0.781	0.431
28	1481	1476	1467	1466	7.033	0.428	0.856	0.860
35	2133	2125	2113	2102	8.650	0.229	0.594	0.937
42	2845	2810	2813	2804	9.082	0.297	0.239	0.477

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Table 4. Feed conversion ratio of broilers fed either standard or reduced specification diets supplemented with two forms of digestive enhancer

Aged	Standard specification diet		Reduced specification		SEM	P value		
	SYN	Phytase	SYN	Phytase		Feed	Digestive Enhancer	F × DE
7	1.10 ± 0.07[a]	1.18 ± 0.05[b]	1.15 ± 0.04[ab]	1.16 ± 0.05[b]	0.011	0.386	0.032	0.112
14	1.26 ± 0.06	1.31 ± 0.03	1.28 ± 0.05	1.29 ± 0.04	0.008	0.953	0.100	0.343
21	1.34 ± 0.01[A]	1.38 ± 0.02[BC]	1.36 ± 0.02[AB]	1.39 ± 0.02[C]	0.005	0.125	<0.01	0.463
28	1.47 ± 0.02[AB]	1.52 ± 0.03[C]	1.46 ± 0.02[A]	1.50 ± 0.04[BC]	0.007	0.215	<0.01	0.649
35	1.61 ± 0.04[ab]	1.64 ± 0.03[ab]	1.61 ± 0.03[a]	1.65 ± 0.03[b]	0.006	0.965	<0.01	0.786
42	1.73 ± 0.01[ab]	1.79 ± 0.04[c]	1.71 ± 0.03[a]	1.75 ± 0.04[b]	0.007	0.007	<0.01	0.401

[a-b] Values within the rows with no common superscript are significantly different (P < 0.05)
[A-C] Values within the rows with no common superscript are significantly different (P < 0.01)

compared to those on the standard formulation (P = 0.007). No interactions were observed between treatments.

There were no significant differences in either mortality or EPEF for any of the treatment diets. Mortality was below 6% throughout the trial (Table 5) and the best numeric EPEF was observed for the birds fed the reduced energy diet containing SGN.

Discussion

The trial compared both the impact of reduced dietary specification and the potential benefits of feeding either an SSF-type digestive enhancer (SGN) or a commercial phytase. The data showed that, compared with the birds fed the full specification diets, the birds fed the reduced energy diets had significantly lower cumulative feed intakes at 28 d and 42 d and showed a strong trend for decreased bodyweight at 21 days, regardless of the digestive enhancer included. Birds did not compensate for the lower energy concentration with a higher intake in order to maintain a constant energy intake. This is in contrast with trials by Leeson *et al.* (1996), which provided diets with different energy concentrations, it was reported that a constant energy intake was maintained with no effect on bird weights. In their experiment, reducing the energy level of the diet resulted in reduced carcass fatness. Carcass composition was not analysed in the present trial. At 42d a significant impact of feed specification was observed, whereby the birds fed the reduced energy diet had higher FCRs compared to those on the standard diets.

Table 5. Mortality rate and European Production Efficiency Factor

Parameters	Standard specification diet		Reduced specification diet	
	SGN	Phytase	SGN	Phytase
Mortality and culls, %	5.8	5.2	4.3	5.2
EPEF	369	354	375	362

SGN inclusion led to a significant improvement in feed conversion ratio. This is in agreement with data from Nollet *et al.* (2011), who reported improved FCR in broilers feed a wheat based diet with SGN supplementation. However, in their trial the effect was less consistent and influenced by the variety of wheat in the diet. Peric *et al.*, (2013) has reported improved FCR in laying hens feed SGN where the main ingredients of the diet were corn and soy, similar to the present study.

Conclusion

SGN shows considerable potential to improve FCR in broilers, and this study confirmed the findings of other trials, whereby SGN improved FCR in growing chickens. However, further research is needed, to elucidate the mechanisms involved and to more profoundly understand potential interactions with dietary ingredients and overall diet composition. In addition potential effects on carcass composition should be evaluated in detail.

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Declaration of Interest

None

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