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ANSInet
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan
Mob: +92 300 3008585, Fax: +92 41 8815544
E-mail: editorijps@gmail.com

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Meta-analysis of Laying Hen Trials Using Diets With or Without Allzyme® SSF Enzyme Complex

D.M. Hooge[1], J.L. Pierce[2], K.W. McBride[2] and P.J. Rigolin[2]
[1]Hooge Consulting Service, Inc., Eagle Mountain, Utah, USA
[2]Alltech, Inc., Nicholasville, Kentucky, USA

Abstract: A statistical meta-analysis was conducted using results from 16 laying hen trials (1995-2008; plus some undated reports) from several countries to demonstrate effects of a dietary enzyme complex (+SSF; Allzyme® SSF, Alltech, Inc., Nicholasville, Kentucky USA) versus no supplement (nCON, negative control) on 6 performance parameters. The paired t-test (Statistix 8, Analytical Software, Tallahassee, Florida USA) was used in the statistical analysis. A total of 26 comparisons from 16 trials were possible for hen-day egg production, egg weight and daily egg mass production and 24 comparisons from 14 trials were possible for daily feed intake, feed/dozen eggs and kg feed/kg eggs. Overall averages for the parameters were calculated and levels of significance (p-values) were given. The inclusion rates for the enzyme product in the diets was listed. Hen-day egg production was numerically (p = 0.136) improved by 1.09% actual (+1.29% relative) for +SSF compared to nCON diets. Egg weight was significantly (p = 0.006) greater for eggs from hens fed +SSF rather than nCON diets (+0.89 g or +1.49%). Daily egg mass produced was significantly greater (p = 0.014) for +SSF than for nCON fed hens (+1.74 g/hen/day or +3.47%). Feed intake was numerically (p = 0.281) lowered by 0.50 g/hen daily (-0.44%) by using +SSF diets compared to nCON diets. Feed/dozen eggs was significantly (p = 0.028) reduced by 0.027 kg/dozen (1.65%) and kg feed/kg eggs was significantly (p = 0.004) reduced by 0.069 (3.04%) for +SSF diets compared to nCON diets. Enzyme supplementation (Allzyme® SSF) at 150 g/tonne of feed is recommended to improve the egg weight, daily egg mass and feed conversion ratios of laying hens.

Key words: Allzyme SSF, enzymes, laying hens, meta-analysis, metabolizable energy, performance

INTRODUCTION

An enzyme complex manufactured by solid-substrate fermentation, rather than conventional liquid fermentation, and containing phytase, starch and non-starch polysaccharide enzymes is commercially available for use in laying hen diets (Allzyme® SSF, Alltech, Inc., Nicholasville, KY). This enzyme product is derived from a naturally selected (non-genetically modified) strain of *Aspergillus niger* produces phytase, xylanase, protease, cellulase, beta-glucanase, amylase (Wu *et al*., 2003), pentosanase and pectinase (Sundu *et al*., 2004). This is a natural complex or system of enzymes of fungal origin.

When the enzyme complex product is included in laying hen feeds at a level of 0.015% (150 g/tonne), it is estimated to release 75 kcal ME/kg (34 kcal ME/lb), 0.1% calcium and 0.1% available phosphorus, as well as 0.2% crude protein, 0.029% lysine, 0.0.11% methionine, 0.009% cysteine, 0.004% tryptophane, 0.014% threonine, 0.024% isoleucine and 0.022% arginine.

This article provides a statistical meta-analysis of 16 feeding trials with laying hens in which effects of negative control and enzyme supplemented diets on productive performance were compared. Using the overall average responses, egg producers can calculate the benefit:cost ratios by production parameter for the enzyme supplement.

MATERIALS AND METHODS

A total of 16 reports, articles and slide presentations collected worldwide allowed comparisons of the effects of negative control (nCON) vs. enzyme supplemented (+SSF) diets on laying hen performance. Countries of origin included Australia, Brazil, China, Colombia, India, Mexico, Poland and Thailand. The results were analyzed by paired t-test using Statistix 8 (Analytical Software, Tallahassee, Florida; www.statistix.com) to obtain overall averages for each of the 6 parameters: hen-day egg production, egg weight, daily egg mass, feed consumption, feed/dozen eggs and kg feed/kg eggs. The levels of significance for the paired t-tests were reported as p-values. The inclusion rates of the enzyme product in the supplemented diets were listed.

RESULTS AND DISCUSSION

Hen-day egg production was numerically (p = 0.136) improved by 1.09% actual (+1.29% relative) for +SSF compared to nCON diets (Table 1). Egg weight was significantly (p = 0.006) greater from hens fed +SSF rather than nCON diets (+0.89 g or +1.49%) (Table 1). Daily egg mass produced was significantly greater (p = 0.014) for +SSF than for nCON fed hens (+1.74 g/hen/day or +3.47%) (Table 1). Feed intake was numerically lowered by 0.50 g/hen daily (-0.44%) by using +SSF diets compared to nCON diets (Table 2).

Corresponding Author: P.J. Rigolin, Alltech, Inc., Nicholasville, Kentucky, USA

Table 1: Statistical meta-analysis of hen-day egg production, egg weight and daily egg mass in 16 laying hen trials worldwide providing 26 comparisons of negative control (nCON) versus Allzyme® SSF (+SSF) supplemented diets

	Level of SSF	Hen-day egg % (vs 0)		Egg weight, g. production, %		Daily egg mass, g/hen/day	
Reference	g/tonne[1]	nCON	+SSF	nCON	+SSF	nCON	+SSF
Collazos (undated)	1,000	92.37	93.12	56.96	60.63	48.60	56.46
Collazos (undated)	1,480	92.37	94.65	56.96	61.52	48.60	58.23
Collazos (undated)	1,830	92.37	92.63	56.96	60.21	48.60	55.77
Collazos (undated)	1,000	89.14	94.71	58.69	59.11	52.32	55.98
Collazos (undated)	1,480	89.14	92.96	58.69	61.39	52.32	57.07
Collazos (undated)	1,830	89.14	93.00	58.69	60.67	52.32	56.42
Devegowda *et al*., 2008	1,000	91.38	91.80	54.10	54.10	49.44	49.66
Devegowda *et al*., 2008	1,000	89.72	90.69	53.30	55.80	47.82	50.61
Kaminska *et al*., 1995	1,000	80.40	86.60	61.70	61.60	49.61	53.35
Kaminska *et al*., 1995	1,000	86.60	85.00	61.50	60.80	53.26	51.68
Kaminska *et al*., 1995	1,000	86.50	85.30	61.10	61.50	52.85	52.46
Rossi *et al*., 2007	150	75.63	74.83	54.80	55.57	41.45	41.58
Rossi *et al*., 2007	150	81.68	80.06	60.08	61.73	49.07	49.42
Rossi *et al*., 2006	150	75.66	74.50	55.33	55.75	41.84	41.55
Rossi *et al*., 2006	150	81.95	90.05	59.90	62.12	49.11	49.78
BARC (Undated)	200	94.60	95.45	63.60	63.30	60.17	60.42
Rutz (undated)	150	86.30	85.65	56.70	56.23	48.93	48.16
Arrieta and Valle, 2008	150	71.27	79.64	63.39	62.77	43.81	49.99
Nunes *et al*., 2007	150	80.86	76.65	65.69	66.29	53.12	50.81
Gentilini *et al*., 2007	150	88.56	88.74	60.60	59.28	53.67	52.61
Avila and Fuente, 2006	150	69.00	72.00	66.00	66.00	45.00	47.00
Dallmann *et al*., 2006a	150	84.20	85.40	64.00	65.00	53.89	55.51
Dallmann *et al*., 2006b	150	90.60	82.20	65.00	66.00	58.89	54.25
Quigang *et al*., 2004	200	78.44	78.57	62.38	62.42	48.94	49.03
Cheng *et al*., 2004	200	88.00	87.59	54.44	54.43	47.91	47.68
Nunes *et al*., 2007	50	78.80	81.23	64.75	64.26	51.02	52.20
Avg		84.80	85.89	59.82[b]	60.71[a]	50.09[b]	51.83[a]
Diff.			+1.09		+0.89		+1.74
Diff., %			+1.29		+1.49		+3.47
p-value			0.136		0.006		0.014

[1]There was a change in concentration of the product allowing lower inclusion rates in references Rossi *et al*., 2007 though Nunes *et al*., 2007.
Note that amount released was always considered to be 0.1% for calcium and 0.1% for available phosphorus.

Table 2: Statistical meta-analysis of feed intake, feed/dozen eggs and feed/kg eggs in 15 laying hen trials worldwide providing 24 comparisons of negative control (nCON) versus Allzyme® SSF (+SSF) supplemented diets

	Level of SSF	Feed intake, g/hen/day		Feed kg/dozen eggs		Feed kg/kg eggs	
Reference	g/tonne[1]	nCON	+SSF	nCON	+SSF	nCON	+SSF
Collazos (undated)	1,000	115.1	114.5	1.495	1.476	2.150	2.050
Collazos (undated)	1,480	115.1	114.9	1.495	1.457	2.150	1.920
Collazos (undated)	1,830	115.1	114.3	1.495	1.481	2.150	2.070
Collazos (undated)	1,000	116.3	116.8	1.566	1.480	2.170	1.980
Collazos (undated)	1,480	116.3	115.4	1.566	1.490	2.170	2.000
Collazos (undated)	1,830	116.3	115.7	1.566	1.493	2.170	2.020
Kaminska *et al*., 1995	1,000	128.0	128.0	1.910	1.774	2.580	2.399
Kaminska *et al*., 1995	1,000	126.0	126.0	1.746	1.779	2.366	2.438
Kaminska *et al*., 1995	1,000	126.0	126.0	1.803	1.773	2.460	2.402
Rossi *et al*., 2007	150	86.27	86.54	1.730	1.750	2.680	2.630
Rossi *et al*., 2007	150	88.57	88.80	1.630	1.670	2.280	2.270
Rossi *et al*., 2006	150	108.3	108.5	1.718	1.748	2.640	2.620
Rossi *et al*., 2006	150	110.7	111.0	1.621	1.479	2.260	2.240
BARC (Undated)	200	112.0	112.0	1.421	1.408	1.864	1.849
Rutz (undated)	150	111.1	111.8	1.545	1.552	1.960	1.970
Arrieta and Valle, 2008	150	108.0	107.7	-	-	2.465	2.154
Nunes *et al*., 2007	150	119.7	116.0	1.770	1.820	2.290	2.290
Gentilini *et al*., 2007	150	115.9	111.7	1.570	1.510	-	-
Avila and Fuente, 2006	150	99.00	105.0	1.722	1.750	2.207	2.216
Dallmann *et al*., 2006a	150	114.9	108.9	1.640	1.540	2.132	1.962
Dallmann *et al*., 2006b	134.0	129.0	1.770	1.760	2.275	2.378	
Quigang *et al*., 2004	200	116.3	115.8	1.778	1.769	2.376	2.362
Cheng *et al*., 2004	200	111.2	110.9	1.517	1.519	2.322	2.326
Nunes *et al*., 2007	150	109.3	111.4	1.664	1.645	2.142	2.133
Avg	113.3	112.8	1.641[a]	1.614[b]	2.272[a]	2.203[a]	
Diff.		-0.50		-0.027		-0.069	
Diff., %		-0.44		-1.65		-3.04	
p-value		0.281		0.028		0.004	

[1]There was a change in concentration of the product allowing lower inclusion rates in references Rossi *et al*., 2007 though Nunes *et al*., 2007.
Note that amount released was always considered to be 0.1% for calcium and 0.1% for available phosphorus.

Feed/dozen eggs was significantly (p = 0.028) reduced by 0.027 kg/dozen (1.65%) for +SSF diets compared to nCON diets (Table 2). Similarly, kg feed/kg eggs was significantly (p = 0.004) reduced by 0.069 (3.04%) for +SSF diets compared to nCON diets (Table 2).

Enzyme supplementation numerically improved two production parameters (hen-day egg production and feed intake) and significantly improved four other production parameters (egg weight, daily egg mass, feed/dozen eggs and kg feed/kg eggs). In conclusion, overall results of the meta-analysis revealed that +SSF diets numerically increased hen-day egg production and decreased feed intake and significantly increased egg weight and daily egg mass and reduced feed/dozen eggs and kg feed/kg eggs. Therefore, enzyme supplementation (Allzyme® SSF) at 150 g/tonne of feed is recommended to improve the productive performance of laying hens.

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