

The interactions between balanced protein level and feed form in broiler production

A. Lemme^{1,3*}, J. van Wichen², P.J.A. Wijten², D.J. Langhout² and A. Petri¹, ¹Degussa AG, FA-M-AN, Rodenbacher Chaussee 4, 63457 Hanau, Germany, ²Provimi B.V., Postbox 5063, 3008 AB Rotterdam, The Netherlands, ³E-mail: andreas.lemme@degussa.com

Abstract

In two feeding trials with 14-35 days old male broilers the effects of increasing levels of balanced protein (90-120% of Dutch recommendation) offered in coarse mash (with variable and non-variable particle size distribution) and pelleted diets (good and poor quality) on various performance criteria were examined. Feed intake generally decreased with increasing balanced protein levels. However, highest feed intake was observed with good pellets which was then reflected by higher weight gain and – at least in one trial – by better feed conversion ratio compared to the bad quality pellets or mash treatments. Increasing balanced protein levels only slightly affected weight gain when fed as mash. For the poor pellet treatments there was a clear linear response but on a lower performance level as good pellets. Data suggest that optimum dietary amino acid levels vary with feed form and pellet quality.

Introduction

Increased weight gain is often driven by enhanced feed intake. Physical appearance of the feed is one important factor. Commonly pelleted feed is fed but (coarse) mash feeding is also successfully applied in some regions (e.g. Belgium). The quality of pellets can vary affecting the animal performance. In addition, there is some evidence that optimum dietary amino acid levels depend on feed form (Greenwood and Beyer, 2004). Two experiments with growing broilers were conducted in order to examine effects and potential interactions between feed form/quality and dietary amino acid levels.

Materials and Methods

In the first trial a total of 1440 male 14 days old Ross 308 broilers were equally allocated to 72 cages with 20 birds each. Six replicate pens were assigned to each of 12 dietary treatments in a 3 (feed forms) x 4 (balanced protein levels, AA-levels) factorial arrangement. The feed forms included coarse mash, poor and good quality pellets whilst the four AA-levels comprised 90 to 120 % of the CVB (2001) Lys standard. The compositions of the extreme diets are given in Table 1. Aliquots of both diets were blended to certain proportions in order to achieve the intermediate levels of 100 and 110 % CVB. The diets were formulated to meet CVB (2001) energy and nutrient recommendations except for app. dig. Lys (and all other essential amino acids (EAA)) which was increased from 0.92 to 1.22 % (0.97 to 1.27 % true fec. dig. Lys). The applied amino acid profile was as follows (in % of dig. Lys on basis of app. dig. EAA (in brackets on basis of true fec. dig. EAA): Met+Cys 75 (77), Thr 63 (65), Trp 22 (21), Ile 75 (77), Val 81 (87), and Arg 112 (110). All diets were analysed for protein and amino acids, consistently confirming the expected values. Feeds and water were offered *ad libitum*.

To produce the coarse mash wheat and corn were ground on a roller mill with 1.5 and 2.5 mm distance between the rolls. About 70 % of the feed had a particle size between 0.8 and 2.5 mm while particles >2.5 mm made about 25 %. Due to changing inclusion levels of soybean meal, particle size distribution varied. For the pelleted diets the coarse ground wheat and corn were ground again on a hammer mill with a 5 mm sieve. Good quality pellets were produced by using a pelleting matrix with a 4 x 70 mm die with steam addition whilst the poor quality pellets were produced by using a pelleting matrix with a 4 x 40 mm die without steam. The

Holmen test of feed samples obtained from the feeders at day 35 revealed an average after-test-dust content of 17.6 % and an average durability of 86.5 % in the good pellet treatments whereas the poor pellet quality was characterised by an average after-test-dust content and durability of 82.0 % and 27.4 %.

Table 1: Experimental diets with 90 and 120% apparent digestible Lys according to CVB (2001) for 14 to 35 days old broilers

Ingredients, % of diet	90 % of CVB	120 % of CVB	Energy and nutrients (%) of diet*	90 % of CVB	120 % of CVB
Wheat	26.0	21.0	Energy, MJ AME/kg*	12.55	12.55
Corn	39.0	31.5	Ideal (crude) protein	19.5	24.6
Soybean meal	22.8	30.0	AFD Lys**	0.92	1.22
Corn gluten meal	2.30	2.30	AFD Met+Cys	0.69	0.92
Soybean protein	0.25	2.73	AFD Thr	0.58	0.77
Potato protein	0.25	1.42	AFD Trp	0.20	0.26
Fat blend	5.04	6.82	AFD Ile	0.68	0.91
L-Lys HCl	0.22	0.19	AFD Val	0.76	0.99
DL-Met	0.14	0.26	AFD Arg	1.03	1.37
L-Thr	0.001	0.005	Calcium, total	0.80	0.80
Vitamins, Minerals, etc.	4.00	3.78	Available phosphorous	0.38	0.38

* AME_(broiler) according to Dutch system corresponds to roughly 13.45 MJ ME/kg according to WPSA formula ** AFD - apparent fecal digestible, 0.92 and 1.22 AFD Lys correspond to 0.97 and 1.27 true fecal digestible Lys, respectively.

Body weights and feed consumption were recorded from day 14 to 35. As there were large differences in body weight, FCR was corrected for body weight gain based on the overall average of 1799 g (+/- 0.04 per 100g) After termination of the experiment, 5 birds per cage were selected for carcass evaluation. Breast meat yield was also standardised -0.2%-points for each 100g above 2125 g body weight. Data were analysed by ANOVA and a multiple range test considering $p < 0.05$ significant.

The second trial was conducted with exactly the same design and nutrient and energy levels in the feed. Only, the ingredient composition differed slightly as diets were adjusted to the amino acid analyses of the raw materials. In this trial, good pellets and two kinds of mash diet were produced. One mash diet was similar to the previous trial where changing balanced protein levels varied the particle size distribution. In the second mash such particle size variation was avoided in order to study whether particle size distribution has an effect on the broiler's responses in the examined criteria.

Results and Discussion

Technical results for weight gain and feed conversion ratio of the first trial are shown in Table 2. Weight gain was generally on a high level ranging between 1761 g (poor pellet / 90 % AA) and 1978 g (good pellet / 110 % AA) in the first trial and between 1679 g (non-variable mash / 90 % AA) and 1962 g (pellet / 120% AA). For the pelleted diets a clear performance improvement with increasing AA-levels could be observed confirming a number of previous AA-experiments (Lemme, 2003). However, weight gain in coarse mash fed birds

was rather unaffected in both trials by amino acid supply. At least at higher balanced protein levels, there was an advantage in poor quality pellet fed birds compared to mash fed birds. Weight gain data may suggest, that higher dig. AA acid levels are required in poor quality pellets in order to achieve the same performance as with good quality pellets whilst it seems, that maximum performance and thus optimum dietary amino acid levels are lower in mash compared to pellets. The latter would be in line with results reported by Greenwood and Beyer (2004)

Table 2: Effect of graded balanced protein levels in diets offered as either coarse mash with variable or non-variable particle size distribution or as pellets with good or poor quality on feed intake (FI), weight gain, feed conversion ratio (FCR, corrected, see text), and breast meat yield (BMY, corrected, see text) in male broilers 14 – 35 days of age

		Balanced protein levels, % of CVB recommendation											
		90	100	110	120	90	100	110	120	90	100	110	120
Experiment 1													
		Mash (variable)				Pellets (good)				Pellets (poor)			
FI		2972 ^{bc}	2863 ^{de}	2823 ^{ef}	2745 ^f	3175 ^a	3194 ^a	3143 ^a	3054 ^b	2963 ^c	2921 ^{cd}	2923 ^{cd}	2868 ^{de}
Gain		1805 ^{cd}	1808 ^{cd}	1832 ^{bc}	1806 ^{cd}	1869 ^b	1935 ^a	1978 ^a	1954 ^a	1761 ^d	1808 ^{cd}	1846 ^{bc}	1872 ^b
FCR		1.67 ^{bc}	1.60 ^{de}	1.55 ^{fg}	1.54 ^g	1.69 ^{ab}	1.62 ^{de}	1.54 ^g	1.53 ^g	1.72 ^a	1.64 ^{cd}	1.59 ^{ef}	1.53 ^g
BMY		31.6 ^d	32.2 ^{bcd}	32.9 ^{ab}	32.5 ^{bc}	32.3 ^{bcd}	32.1 ^{cd}	32.5 ^{bc}	32.7 ^{abc}	33.2 ^a	32.7 ^{abc}	32.9 ^{ab}	32.6 ^{abc}
Experiment 2													
		Mash (variable)				Pellets (good)				Mash (non-variable)			
FI		2947 ^c	2846 ^d	2801 ^{de}	2721 ^f	3159 ^a	3131 ^a	3040 ^b	3038 ^b	2876 ^{cd}	2861 ^d	2813 ^d	2729 ^{ef}
Gain		1730 ^{cd}	1732 ^{cd}	1771 ^c	1758 ^c	1847 ^b	1921 ^a	1916 ^a	1962 ^a	1679 ^d	1753 ^c	1771 ^c	1748 ^c
FCR		1.73 ^{ab}	1.67 ^c	1.59 ^d	1.56 ^{de}	1.69 ^{bc}	1.58 ^{de}	1.54 ^e	1.48 ^f	1.76 ^a	1.65 ^c	1.60 ^d	1.58 ^{de}
BMY		31.2 ^e	32.0 ^{bcd}	32.5 ^{ab}	32.3 ^{ab}	31.6 ^{cde}	31.9 ^{bcd}	32.5 ^{ab}	32.3 ^{abc}	31.3 ^{de}	32.2 ^{abc}	32.8 ^a	32.5 ^{ab}

Feed intake decreased with increasing AA-levels. The magnitude seemed to be strongest for mash fed broilers whereas it was less pronounced in pellet fed birds. The particle size distribution had no effect on feed intake. Feed conversion ratio (FCR, corrected for body weight) consistently improved up to 15 points with increasing AA-levels regardless feed forms and qualities. However, whilst there was no difference in FCR between the good pellets and coarse mash treatments in trial 1, FCR was clearly better for the pellet treatments than for the mash treatments in trial 2. With respect to the second trial it seems that higher dietary AA levels are necessary in mash diets to achieve the same FCR as with pellets.

Responses on breast meat (% of carcass) suggested increasing yield up to 110 % AA level except for poor pellet quality showing the contrary trend. There is currently no explanation for this effect with poor pellets. Except this effect no significant differences were found between feed forms for breast meat yield.

It is concluded that optimum dietary amino acid levels are influenced by feed form (mash vs. pellets) and pellet quality (good vs. poor) whilst particle size distribution in mash feed had no effect.

References

CVB (2001) Veevoedertabel (Livestock Feed Table). *Central Bureau for Livestock Feeding (CVB)*, Lelystad, The Netherlands.

Greenwood, M.W. and Beyer R.S. (2004) Effect of feed manufacturing on broiler performance. *AminoNews*TM **5 (2)**: 13-20.

Lemme, A. (2003): The “Ideal Protein Concept” in broiler nutrition – 2. Experimental data on varying dietary Ideal Protein levels. *AminoNews*TM **4 (2)**: 7-14.