

Genotype – nutrition interactions in broilers; response to balanced protein in two commercial strains.

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Abstract

A trial using different levels of balanced protein showed significant and economically important differences in the response of commercial broiler strains. At deficient levels one strain maintained feed intake and therefore grew better. Only one of the two strains showed continuing important responses to protein levels higher than those normally recommended. The importance of determining optimum amino acid and protein levels by economic analysis of response data is emphasised by these findings.

Introduction

In recent years studies of amino acid requirements have been superseded by determination of the response to balanced or 'ideal' protein (IP), (Lemme 2003). Aviagen has observed, in several studies, that different modern broiler strains show characteristically different responses to IP and here an experiment which quantifies such effects is described.

Materials and Methods

Day-old chicks from two commercial strains, A and B, were obtained from the same hatchery. Parents were 37 and 40 weeks of age respectively and chick weights 42.3 and 43.8g. The trial design comprised 2 strains, 2 sexes and 5 IP levels in a factorial design with 4 replicates per treatment each of 90 chicks. Temperature and humidity were controlled as in Aviagen (2002), light (about 15 lux and per day) was 23 (0-7d), 20 (8-21d) and 23 hours.

Dietary IP levels were defined by digestible (dig) LYS levels as proportions (0.8, 0.9, 1.0, 1.1 and 1.2) of the recommended reference levels (Aviagen, 2002) in starter crumbles (0-10d), grower pellets (11-28d) and finisher pellets. Reference levels of dig. LYS and AMEn (g/kg//MJ/kg) were 12.7//12.6; 10.8//13.3 and 8.8//13.5 in starter, grower and finisher feeds respectively. Minimum levels of digestible amino acids were related to dig. LYS as recommended in Aviagen (2002). Feeds were formulated using wheat, soybean meals, maize germ meal, sunflower meal and some fishmeal, together with L-lysine HCl, DL- methionine and L-threonine, to achieve the desired amino acid balance. Feeds and water were offered *ad libitum*. No growth promoter or coccidiostat were in the feeds. Chicks were vaccinated for IB and ND at the hatchery and against coccidiosis (Paracox-5, Schering-Plough Animal Health) at day-old.

Records of bodyweight, feed intake, body composition and other factors were maintained throughout the trial to 46 days. Mortality data include birds culled because of leg defects.

Results and Discussion

There were significant ($P<0.05$) interactions between strain and IP level for live weight at all weighings (28, 32, 40 and 46 days) except at 10 days. By contrast sex-IP level interactions were only significant after 40 days of age. The nature of the strain interaction is shown in Figure 1 by average male and female data at three ages.

At 10-d strain B is larger than strain A at all IP levels. By 32-d, the responses of the two strains cross over. At deficient IP levels strain B is clearly faster growing than strain A whilst at the recommended IP level the strains are similar. At high IP levels strain B stops responding and may even show a decline in growth rate, whilst strain A continues to respond to the highest level used.

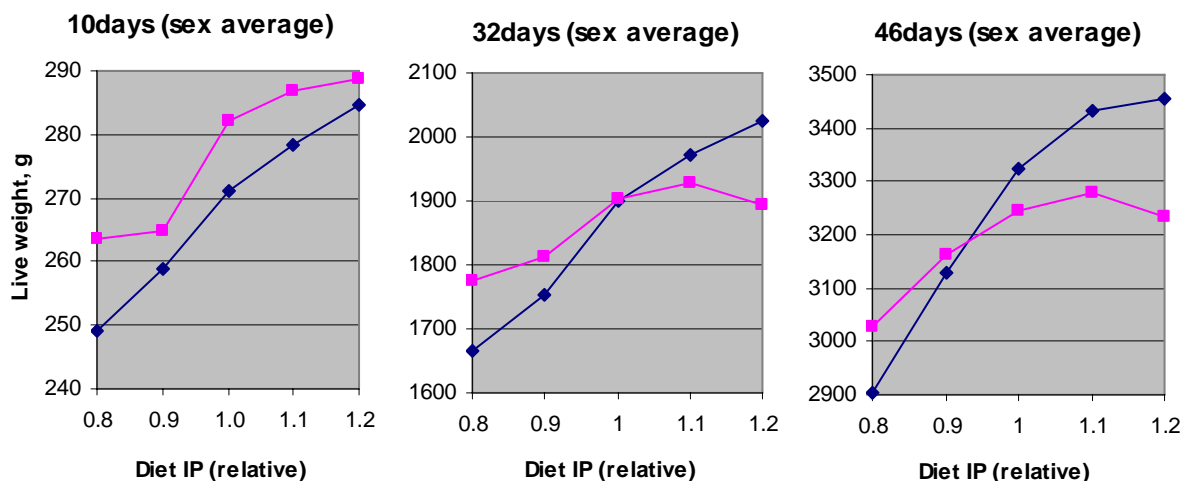


Figure 1. Responses of broiler strain A (—) and B (—) to dietary IP level. Live weight (g) at 10, 32 and 46 days of age.

Results for some production characteristics at 40 days of age are shown in Table 1. In all cases the main effects of strain and IP level are highly significant ($P < 0.01$). The strain-IP level interaction is not significant for FCR but is in the other cases ($P < 0.05$). Interactions between diet and sex are relatively less important.

Table 1. Effect of dietary IP level on performance of two broiler strains to 40 days of age. Mean data for males and females and the significance of some effects

IP-level	Mortality, %		Body weight, g		FCR, adj. for mortality		PEF	
	Strain A	Strain B	Strain A	Strain B	Strain A	Strain B	Strain A	Strain B
0.8	3.47	8.47	2355	2519	1.97	2.07	289	279
0.9	3.47	9.57	2565	2623	1.85	1.94	335	305
1.0	2.50	11.81	2735	2712	1.77	1.87	376	318
1.1	2.92	13.33	2828	2764	1.74	1.82	396	330
1.2	4.72	16.81	2855	2733	1.69	1.78	404	318
Significance of effects (P value)								
Strain	0.000		0.874		0.000		0.000	
IP-level	0.002		0.000		0.000		0.000	
Strain-x-IP	0.029		0.000		0.930		0.000	
Sex-x-IP	0.065		0.048		0.253		0.134	

The differences in response to dietary IP level by these two strains of commercial broilers are very striking. In simple terms strain B tolerates amino acid deficiency better than strain A whilst at higher IP levels strain A continues to show economically important responses to increments of IP whilst strain B shows smaller or even negative responses. The pattern of response in mortality is also very different.

In seeking an explanation of these interactions one obvious question is whether the greater tolerance of strain B for deficient feeds is accounted for by differences in feed intake. These are shown in Figure 2a and are very distinctive. When live weight gain is plotted against digestible LYS intake (Figure 2b) strain B is seen to be less responsive to dig. LYS intake than strain A. This smaller response is also seen in breast meat yield (Figure 2c).

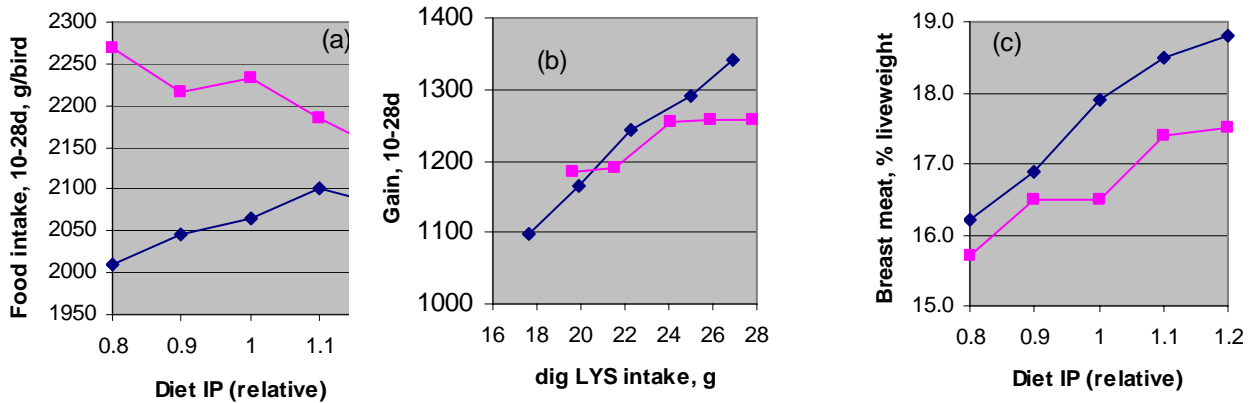


Figure 2. Food intake (a) and the response of live weight gain to IP intake (b) during the period 10 to 28 days in strain A (—) and strain B (—) broilers. Data for breast meat (c) were collected at 32 days.

These findings have important commercial implications. The correct level of protein nutrition has to be determined on economic grounds taking account of the bird responses defined in experiments such as this. A general analysis using the Aviagen Protein Calculator is described by Kenny, Kemp and Fisher (2004). From the data of the present trial (Figure 3) it is clear that the levels of IP which maximise margin will differ for these two strains of commercial broiler. As expected, the optimum IP levels are higher when responses in processing performance, e.g. meat yield, are included in the analysis as compared to the farm gate.

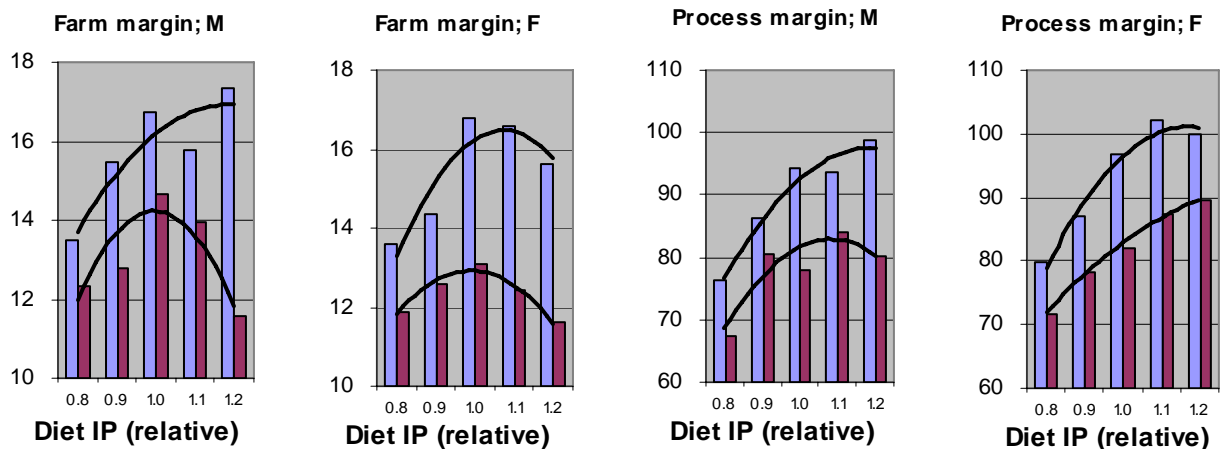


Figure 3. Calculated margins, ignoring mortality, (€ cents per bird) at different levels of IP when evaluated at the farm (revenue from live weight) or after processing (revenue from breast and dark meat and wing portions). Feed costs and other prices typical for the UK industry (end 2004). Data for strains A (blue) and B (purple), M(ale) and F(emale) with fitted quadratic curves.

References

- AVIAGEN (2002) Ross Broiler Management Manual. *Aviagen Ltd.*, Newbridge, UK.
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