Protein, fat and energy deposition of slow-growing broiler fed with organic diets

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Zusammenfassung

In der vorliegenden Studie wurde der Eiweiß-, Fett- und Energieansatz an männlichen und weiblichen Broilern einer langsam wachsenden Herkunft (ISA J-257) untersucht. Es wurden Futtermischungen mit ökologisch erzeugten Futtermitteln, die abgesenkte Energie- sowie Gehalte an essenziellen Aminosäuren aufwiesen, getestet. Tiere wurden im Alter von 0, 14, 28, 42 und 56 Tagen geschlachtet. Für jede Altersstufe wurde das Gesamtkörpergewicht (WBW) analysiert sowie die Eiweiß-, Fett- und Energiegehalte bestimmt, um den jeweiligen Ansatz zu kalkulieren. Diese Werte wurden in Gompertz- Wachstumskurven eingesetzt.

Das Fütterungsregime hatte keinen signifikanten Einfluss auf die untersuchten Merkmale. Nach 28 Tagen zeigten die männlichen Tiere eine höhere WBW-Zunahme, und am 56. Tag einen höheren Energie- und Proteinansatz als die weiblichen Tiere. Nach der Gompertz-Kurve erreichten die männlichen Tiere eine höhere WBW-Zunahme sowie einen höheren Energie-, Eiweiß- und Fettansatz. Die weiblichen Tiere erreichten früher als die Masthähne das höchste Zunahme-Niveau (11 Tage) sowie den maximalen Energie- (12 Tage) und Proteinansatz (15 Tage). Dagegen erreichten sie den maximalen Fettansatz einen Tag später. Die ökologische Erzeugung langsam wachsender Broiler erfordert ab einem Alter von 30 Tagen unterschiedliche Futterprogramme und Schlachtgewichte für männliche und weibliche Tiere.

Introduction

The knowledge of nutrients and energy deposition in broilers is decisive in determining the minimum energy (AME) used in the formulation of diets for periods. Several studies refer to fast growing broilers (less than 2 kg body weight) under conventional production systems. However, there is not enough information available to understand protein, fat and energy deposition in organic slow-growing broilers (growth to 3 kg or larger). Birds fed with low energy (< 12 MJ/AME/kg) and EAAs organic diets (constant amino acid : energy rate) were able to produce carcasses with similar performances and lower feeding costs than their counterparts fed with high energy and amino acid diets (Bellof et al. 2005). The purpose of this study was to evaluate WBW growth rate, protein, fat and energy rates deposition of male and female, slow-growing broilers fed with organic diets. Here the diets had different amino acid and energy densities (constant amino acid : energy ratio).

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Material and Methods

The trial was carried out at the poultry facilities of the University of Applied Sciences, Weihenstephan. In total, 972 one-day-old ISA J-257 male and female chicks from an organic flock were used and kept according to the Council Regulation for organic production (EEC), but no outdoor access was given. They were distributed into 24 pens (2 sexes, 4 diets, 3 replicates; 40 birds/pen; 6m^2/pen). To study the age effects (5 ages) on rates of WBW growth, protein, fat and energy deposition; 12 chicks (6 of each sex) were slaughtered at 0 d and 3 chicks/pen at 14, 28, 42 and 56 d. The WBW were put in plastic bags and frozen (-20°C) until their analysis took place. At the same time feed intake was recorded. The trial involved a rearing phase (from 1 to 28 days) and a fattening phase (from 29 to 56 days) (Table 1). More information is detailed in Bellof et al. (2005).

Table 1: Design of the experiment

Item	Rearing phase (feeding group)				Fattening phase (feeding group)			
	I	II	III	IV	I	II	III	IV
AME, MJ/kg	12.00		11.00		12.40	12.40	11.20	11.20
Lys/AME, g/MJ	0.85		0.85		0.72	0.65	0.72	0.65
Met/AME, g/MJ	0.31		0.31		0.27	0.24	0.27	0.24
Lys, g/kg	10.20		9.35		8.93	8.04	8.06	7.26
Met, g/kg	3.72		3.41		3.35	3.01	3.02	2.72

Source: Bellof et al. (2005). Amounts of the most important EAAs (g EAA/MJ AME) were according GfE (1999). Feed ingredients were conformed to organic standards.

For chemical analyses, frozen WBW were thawed, weighed and autoclaved (1 atm, 121°C x 40 min.). According to pen and age they were chopped up and homogenized in a blender. Then a sample was freeze-dried. Dry matter, protein and fat were analyzed (Naumann and Bassler, 1988) to estimate protein and fat deposition. Energy retained = Protein retained x 23,1 + Fat retained x 38,7 (Brouwer, 1965). Data were analyzed following the GLM procedure of SAS. Rates of WBW growth and of nutrients deposition (0, 14, 28, 42, 56 d) were fitted according to the Gompertz function: Wt= A*exp(-exp(-B(M-t*))) + ei; Wt weight at time t (d), A mature weight (g), B maturity constant (per d), M age with maximum growth rate, and ei denotes the residual error.

Results

Despite the differences reported among diets in the previous study (Table 2; Bellof, 2005) with an advantage for low AME and EAA diets, they were not detected in the present trial (P>0,05) for WBW, protein, fat and energy rate deposition. However, the trends remain. Effects of the main factors (sex, age) and their interaction were detected. After 28 d, males showed a superior WBW compared to females (P<0,001): 778,8 *vs*.708,8 g; 1500,6 *vs*.1344,0; 2358,8 *vs*. 1936,5 g. These results are related to the high feed intake and good feed efficiencies of males (Table 2). The high growth rates of males were reflected in high protein (P<0,001) and energy rate depositions (P<0,05). Fat rate deposition was similar between sexes (P>0,05) Table 3).

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Table 2: Fattening and carcass performance of males (M) and females (F) and different feeding groups of slow-growing broiler

Item	M	F		I	II	III	IV	
Feed intake, g/d	95,9	81,1	***	87,5^{ac}	84,2^{a}	90,5^{bc}	91,8^{b}	**
Feed efficiency, kg/kg	2,12	2,19	*	2,04^{a}	2,09^{ab}	2,19^{b}	2,31^{b}	***
Carcass, g	1722	1411	***	1651^{a}	1555^{b}	1563^{b}	1497^{c}	***

Source: Bellof et al. (2005); $^{a-b}$ means within a row description with different superscripts differ significantly (P<0,05); *, **, *** significant at P<0,05; P<0,01 and P<0,001 respectively

Table 3: Deposition of nutrients and energy (g/d or kJ/d) of males (M) and females (F) at different age of slow-growing broiler

Item	M	F		14 d		28 d		42 d		56 d		
				M	F	M	F	M	F	M	F	
Protein	8,1	6,7	***	2,7	2,7	7,4	6,9	10,4	9,0	11,8^{a}	8,4^{b}	***
Fat	5,6	5,0	NS	1,4	1,6	3,1	3,6	7,9	6,8	9,7	8,0	NS
Energie	403	349	*	117	124	291	299	546	473	648^{b}	504^{b}	*

$^{a-b}$ means within a row description with different superscripts differ significantly (P<0.05); *, **, *** significant at P<0.05; P<0,01 and P<0,001 respectively

As expected, all deposition rates increased significantly with the age of birds (P<0.001). Additionally, males showed higher protein and energy rate depositions than females at 56 days (P<0,001).

According to the estimated Gompertz growth curves (Figure 1), males reached the maximum rates of WBW growth (51 d, 60 g/d *vs*. 40 d, 45 g/d), energy deposition (59 d, 679 *vs*. 47 d, 504 kJ/d) and protein deposition (51 d, 12,7 *vs*. 36 d, 9 g/d) later than females. However, females reached the maximum fat rate deposition (52 d, 7,8 *vs*. 51 d, 9,3 g/d) 1 day later than males. Likewise, they were able to maintain the same deposition ratio for a longer time, and reduced their fat ratio deposition over time slower than males.

Discussion

Male and female broilers of ISA J-257 fed with organic diets reached the maximum growth rate 13 and 6 days later than the strain cross broiler and Ross broiler genotypes under conventional production reported by Scheuermann et al. (2003) and Marcato et al. (2008). Adversely, Santos et al. (2005) found in a study with an ISA Label broiler the longest time to reach this plateau. Consequently, ISA J-257 can be considered an intermediate-growth broiler type. Different growth rates and nutrients deposition between sexes reflect the differences in nutritional requirements and rearing management of both sexes (Gous et al., 1999). The high rates of WBW growth and protein deposition and their long plateau shown for males in comparison to females, reflect the ability of males to benefit from the feed and produce more meat and better carcass composition. The reason for the significant increments of females' fat deposition after 56 d is the birds´ need for extra fat deposition during development of the reproductive function systems (Gous et al; 1999).

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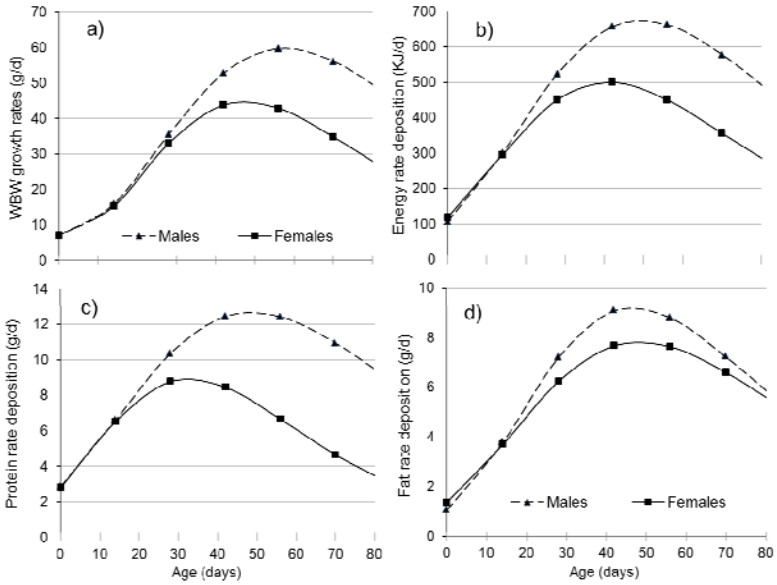

Figure 1: WBW growth rates (a), energy (b), protein (c) and fat (c) rate deposition according sex and age of slow-growing broiler

Conclusions

Slow-growing as well as fast-growing broiler genotypes show intense sex dimorphisms with increasing age in regard to the nutrients and energy deposition rates. As, in the case of slow-growing broilers fed with organic diets, slaughtering takes place between 56 to 80 d, it is necessary to separate sexes from day 30.

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