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Effects of Food Restriction on Rearing Performance and Welfare of a Slow-Growing Chicken Breed: a Behavioural Approach

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Abstract: The purpose of this experiment was to investigate production and welfare implications of food restriction during the rearing period of a slow-growing chicken. Ninety-four as-hatched day-old Ardennaise chicks were raised up to two weeks of age and were then allocated to two treatment groups: *Ad libitum* Feeding (AL) and a Feed Restriction Regime (FR). Body weight, food usage and viability were recorded on a weekly basis from 1-12 weeks of age. Activity and oral behaviours were measured at 8, 9, 10, 11 and 12 weeks of age. Number of birds involved in each of twelve mutually exclusive behavioural categories was recorded. Mean proportion of time spent for each activity was calculated. Significance of effects of treatment, age, time of day and their interactions were measured. At 12 weeks of age, mean body weight was 1117 g (± 189.3 g) (AL) and 1054 g (±187.8 g) (FR). Food usage was 4.16 kg (AL) and 3.43 kg (FR) per bird. Feeding treatment had strong effects on preening ($p<0.001$), feeder directed activity, litter scratching and pecking floor ($p<0.01$) and pacing ($p<0.05$), all activity levels being higher in the FR treatment except for feeder directed activity. Age had strong effects on sitting ($p<0.001$), standing and litter scratching ($p<0.01$). Sitting ($p<0.01$) and litter scratching ($p<0.05$) varied with treatment-age interaction.

Key words: Behaviour, food restriction, slow-growing chicken breeds, welfare

INTRODUCTION

Food restriction of broiler breeders during the rearing period aims at controlling body weight at sexual maturity and thereby improves health and reproductive performances (Hocking *et al*., 1989). Adverse consequences of *ad libitum* feeding on performances include high mortality and multiple ovulations, resulting in reduced breeding performances and output (Hocking *et al*., 1987, 2002). As restricted broiler breeders are continuously hungry, they are much more active than unrestricted birds and show abnormal pacing and oral behaviours characteristic of frustration of feeding (Duncan and Wood-Gush, 1972; Kostal *et al*., 1992; Savory and Maros, 1993). Increasing prevalence of aggressive behaviour has also been identified as both welfare and husbandry problems in commercial broiler breeder flocks (Hocking *et al*., 2004). Overdrinking is also a common problem (Kostal *et al*., 1992) resulting in the need to restrict water intake to maintain litter quality and housing conditions. Among measures for improving welfare, genetic strategies have been proposed. Studies would in fact suggest that replacement of standard broiler breeders with other genotypes and decreasing degree of food restriction may contribute to enhance welfare of commercial breeder flocks (Jones *et al*., 2004). In addition, by comparing tolerance to *ad libitum* feeding of three broiler breeders from different genetic backgrounds, Heck *et al*. (2004) observed higher productivity with *ad libitum* fed slow-growing breeder hens than with restricted broiler breeders. The study of slow-growing breeds from a productive and a behavioural point of view is essential to predict their adaptability to intensive rearing systems. The purpose of this experiment was to investigate production and welfare implications of food restriction during the rearing period in a traditional chicken breed.

MATERIALS AND METHODS

Subjects, husbandry and feeding: Ninety-four as-hatched day-old Ardennaise chicks were raised up to two weeks of age on an *ad libitum* starter mash diet (2937.25 kcal, 22% C.P.) and were then allocated to two treatment groups: 47 birds under *Ad Libitum* (AL) feeding and 45 birds under a Feed Restriction (FR) regime. Birds were fed a typical "Label" mash diet (lower energy and protein than commercial broiler diets, genetically modified organism-free and no coccidiostats) (Table 1) with continuous supply of water. Diets were mainly composed of soybean, wheat and corn. FR diet for both males and females (no sex-separate feeding) was based on feed allowance, as a % of live body weight, of a slow-growing breeder female (Sasso SA31) program (Table 2) (Sasso, 2003).

Thus, to allocate correct amounts of food and to monitor growth rate during rearing, males and females of both diet treatments were weighed on a weekly basis from day-old to 21 days with a small digital scale (HR 2395 model, Phillips, The Netherlands) and with a larger hanging scale (235-6S model, Salter Brecknell, U.K.) at further ages up to 12 weeks of age. Levels of feed restriction imposed to our slow-growing chicken breeders were fairly similar to those practiced in broiler

breeders (2-14%) between 2 and 12 weeks of age (Aviagen, 2008). Each group was fed a mash grower diet (3034.42 kcal, 20% C.P.) between 3 and 12 weeks of age and was housed in one of the two closed pens measuring 1.4 x 1.5 m with floor litter (wood-shavings), with a water dispenser (10 nipple drinkers), a perch of 1m length and one feeder (metal hopper). Chicks, from day-old to 12 weeks of age, were exposed to an artificial standard broiler breeder day length program (Aviagen, 2008), providing 23 h light from day-old to 3 days, 12 hours between 4 and 6 days and 8 h from 1-12 weeks of age. Illumination was provided by cool white fluorescent lamps of 64 Ra and 4300 K (model F36W/133, Havells Sylvania, Germany). Light intensity, measured at floor levels in all pens with a digital luxmeter (Mavolux-Digital, Gossen-Metrawatt GmbH, Germany), varied from 8.96-31.0 lux during rearing. Body weight, food usage and viability of birds were recorded on a weekly basis from 1 -12 weeks of age.

Behavioural observations: Methodology for behavioural observations was based on a previous study (Larivière, 1998; Savory and Larivière, 2000). Activity and oral behaviours were measured at 8, 9, 10, 11 and 12 weeks of age during two 5-min sessions (AM and PM). Number of birds involved in each of twelve mutually exclusive categories (aggressive pecking, drinker directed activity, dust-bathing, feeder directed activity, litter scratching, non-aggressive pecking, pacing, pecking floor, perching, preening, sitting and standing) were recorded every minute. Mean proportion of time spent for each activity was calculated.

Statistical analysis: The final statistical model included treatment, age and their interaction. Observations were presented as untransformed in the result data but significance of effects were measured by ANOVAs using angular (arcsine root) transformed data.

RESULTS AND DISCUSSION

Rearing performance: As expected, controlled reduction of growth rate was achieved in both sexes of the restricted birds (Fig. 1). At 12 weeks of age, full fed birds were heavier 1117 g (± 189.3 g) than their restricted siblings 1054 g (± 187.8 g). Males weighted 1248.8 g (±161.5 g) under AL and 1172.8 g (±125.2 g) under FR. Females had a body weight of 973.5 g (± 82.4 g) (AL) and 867.5 g (±91.3 g) (FR). Body weights of the FR birds were 94 and 89% of those attained in AL males and females respectively. Food usage averaged 4.16 kg per bird in the AL group and 3.43 kg per bird in the FR group. Viability was higher in the AL (96.0%) than in the FR group (93.2%).

Behavioural observations: A preliminary single-factor analysis with ANOVA demonstrated that time of day,

Table 1: Composition proportions (%) of the diets fed to the Ardennaise chicken

	Diets	
Ingredients	Starter	Grower
Wheat	27.04	21.46
Wheat + enzymes	10.0	10.0
Soybean meal	31.92	27.13
Corn	25.0	35.0
Chalk	0.50	0.72
Soybean oil	2.23	2.70
DL-Methionine	0.19	0.16
L-Lysine HCL	0.10	0.14
Dicalcium phosphate	1.92	1.63
Vitamin mix	0.01	0.05
Mineral mix	1.00	1.00
Essential oils	0.1	0.0
Laboratory analysis		
Dry matter (g/kg)	25.89	25.26
Ash (g/kg)	56.09	53.64
Fat (g/kg)	43.06-90.0	49.64-70.0
Crude fiber (g/kg)	872.24	872.72
Crude protein (g/kg)	220.0	200.0
ME (kcal/kg)	2937.25	3034.42

Table 2: Food restriction program of as-hatched Ardennaise chicken breeders (daily food allowance as a % of live body weight) based on a slow-growing breeder female program (Sasso SA31)

Age (weeks)	Food allowance /live body weight (%)
0-2	*ad libitum*
3	14
4	14
5	11
6	11
7	10
8	10
9	9
10	8
11	5
12	5

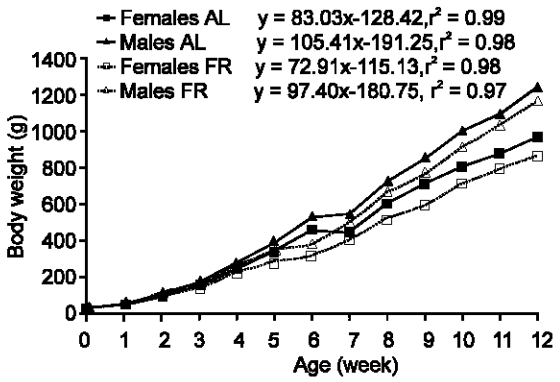

Fig. 1: Linear regression analysis of body weight on age in weeks of male and female Ardennaise chicken breeders fed *ad libitum* (AL) (n = 23 females; n = 25 males) or mild feed restriction (FR) (n = 20 females; n = 25 males), under natural lighting program, from day-old to 12 weeks

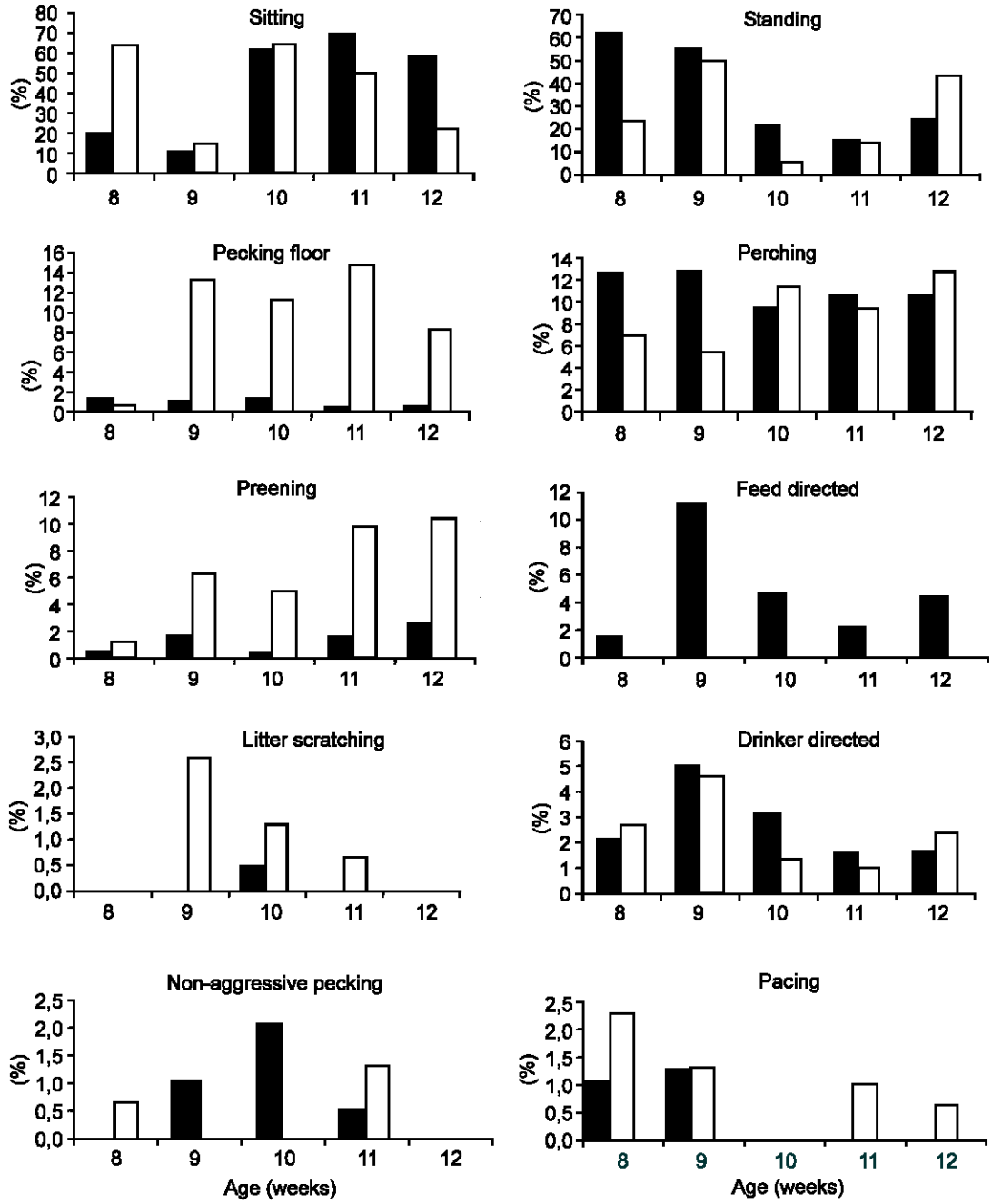

Fig. 2: Overall mean proportions of time spent (%) by the Ardennaise chickens in different activities from *ad libitum* (black columns) and feed restricted (white columns) treatments at 8, 9, 10, 11 and 12 weeks of age

treatment-time of day and age-time of day interactions were not significant with activities. Mean proportions of time spent standing was much greater with AL (>35%) than with FR (<30%). It differed significantly with age (Table 3), decreasing consistently with AL between 8 and 11 weeks and increasing from 10-12 weeks with the FR group (Fig. 2). Time spent sitting, reflecting general inactivity, varied very significantly with age, increasing consistently between 8 and 12 weeks with AL and decreasing from 10-12 weeks with FR. There was a very significant interaction among treatment and age. There was no effect of treatment and proportions of time spent for the activity in both group was the same (<44%). Pecking floor activity varied significantly between feeding treatments and was more frequent in the FR (>10%) than in the AL treatment (<1%). Feeding (or feeder

Table 3: Overall mean proportions (%) of time spent by Ardennaise chickens in different activities on restricted and ad libitum treatments and significance of effects of treatment (Tr), age (A) and their interaction, from ANOVA

			Significance of effects (P)		
Treatment	*ad-libitum*	fed-restricted	Tr	A	TrxA
Perching	11,1%	9,3%	0,159	0,755	0,096
Drinker directed	2,73%	2,47%	0,829	0,158	0,921
Standing	35,63%	27,24%	0,148	0,003	0,068
Sitting	43,91%	43,22%	0,894	0,001	0,005
Preening	1,41%	6,56%	0,000	0,061	0,199
Pacing	1,22%	1,42%	0,034	0,016	0,209
Feeder directed	4,80%	0,00%	0,002	0,074	0,074
Litter scratching	0,52%	1,71%	0,003	0,008	0,011
Non-aggressive	1,04%	1,00%	0,275	0,598	0,382
Dust bathing	0,52%	0,00%	0,341	0,452	0,452
Pecking floor	0,99%	10,76%	0,002	0,283	0,237

directed activity) differed very significantly between treatments and was only observed in the AL treatment (<5%). No observation was made in the FR group (where pecking would have been directed on empty feeders). Scratching at floor litter differed greatly with treatment, age and treatment x age interaction, being greatest with the FR treatment (<2%) and decreasing between 9 and 11 weeks of age. Litter scratching was observed rarely in the AL group (<1%). Preening (while standing or sitting) was very significant between treatments. It was greatest with the FR treatment (>6%), increasing with age and lowest with AL (<2%). Drinking (or drinker directed activity) decreased consistently from 9-12 weeks in both groups where it occupied about 2-3% of time and no significant effects were found. This decrease in drinking activity with more severe food restriction was contrary to a linear increase with increasing degree of restriction reported in broiler breeders (Hocking, 1993). Perching increased slightly between 8 and 12 weeks of age with the FR group (>9%) as opposed to AL (>11%) which seemed to decrease slightly, but no significant effects were found. In slow-growing chickens, perching may represent 19% of total activity (Nielsen, 2004) and is influenced by age, size of the birds and stocking density (Hugues and Elson, 1977; Pettit-Riley and Estevez, 2001). In addition, presence of perches appears to govern aggressive behaviour in broilers (Pettit-Riley *et al*., 2002). Pacing was highly significant with age and treatment and decreased with age in the FR group. Proportions of time spent for this activity was about the same in both groups (<2%). In contrast, exploratory locomotion in hens occupies as much as 16% of the day when kept at low population densities but this decreases to 8% at high stocking densities (Appleby *et al*., 1989).

Non-aggressive pecking (gentle pecking) activity occupied about 1% of time and did not differ significantly between treatments, age and their interaction. Dust-bathing was seen very rarely in the AL feeding treatment (<1%) and hardly at all with treatment FR. There was no significant interaction among treatment, age and their interaction. No aggressive pecking was observed during our observation sessions. Aggressive behaviour is often seen with males under FR and females will display high rates of pecking stereotypies (Blockhuis, 1986; van Niekerk *et al*., 1988; Savory *et al*., 1992). In contrast with results obtained at 8 and 12 weeks of age with two strains of broiler breeders and one layer strain under a FR regime comparable to our programme (Hocking *et al*., 1993), mean proportions of time spent by the fed-restricted Ardennaise between the same ages were within the range for standing and pacing (32%) and for preening (6%), but were higher for sitting (44%) and lower for drinking (2-3%) and scratching and pecking (1-2%).

Conclusion: To summarize results of the behaviour analysis, feeding treatment had strong effects on preening ($p<0.001$), feeder directed activity, litter scratching and pecking floor ($p<0.01$) and pacing ($p<0.05$), all activity levels being higher in the FR treatment except for feeder directed activity. Age had strong effects on sitting ($p<0.001$), standing and litter scratching ($p<0.01$). Sitting ($p<0.01$) and litter scratching ($p<0.05$) varied with treatment-age interaction. Our experiment did not include a control with broiler breeders on the same diet and rearing conditions for comparisons. The effects of feed restriction on production and behaviour should also be studied later in rearing and during the laying period. Finally, effects of feed restriction on welfare of the growing Ardennaise chickens seem comparable to those observed in broiler breeders but need to be further evaluated on an ethical point of view.

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