EFFECT OF ENVIRONMENTAL TEMPERATURES AND ENERGY OR PROTEIN RESTRICTION ON BROILERS CHICKENS CARCASS COMPOSITION

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Background

Over the last few decades, selection for body weight gain and feed conversion efficiency, together with better nutrition have resulted in considerable improvements in broiler performance. However, the broiler chicken also has presented a great amount of fat in the carcass. Thus, recently, the poultry industry became interested in producing a better carcass with less fat to assist the consuming public's demand. The objective of the industry of reducing corporal fat of the broiler chicken, has been difficult to be reached, once the genetic selection for weight gain resulted in an increase of the carcass fat (HARVENSTEIN *et al.*, 1994). CHAMBERS *et al.* (1981), comparing the composition of the carcass between selected and no-selected line, verified that the selected chicken increased the carcass weight and fat, significantly, decreased the nitrogen and ashes of carcass. In the last years, some researches have been suggesting that the fat metabolism in chicken can be controlled submitting the animal to some form of energy restriction during the young phase of growth (PLAVINIK & HURWITZ, 1985, 1989), with subsequent compensatory growth. Broiler chickens also are adversely affected by ambient temperature. High environmental temperatures will have a negative impact on animal production, reducing feed consumption, increasing the feed conversion ratio and therefore, decreasing the growth rate (BOTTJE & HARRISON, 1985). Viscera growth also cold be affect by environmental temperatures (MACARI *et al.*, 1998).

Objectives

Until now, most of the studies about feed restriction in broiler chickens, focused basically if the restricted birds would have a similar weight to the birds fed *ad libitum*. However, it is necessary a better knowledgement of the impact that a restriction program has on the organism (protein gain, as muscle, or fat, as adipose tissue), after refeeding in chickens previously restricted. Thus, the present research was conducted to evaluate the effect of early qualitative energy or protein restriction on broiler carcass composition raised at different environmental temperatures.

Methods

A total of 900 day-old, male chickens from Ross strain were reared in three environmentally controlled rooms where ambient temperature was maintained at 18, 25 and 33°C up 42 days of age. The desired environmental temperatures were achieved using electric heaters and controlled air coolants. The chamber air renewal was made through two fans and two exhaust fans. The environmentally controlled rooms had 16 boxes (2.50 m of length x 1.10 m of width) in a floor pens. For each temperatures chicks were fed *ad libitum* until 7 days of age. At day 8, chicks were assigned to one of three feeding groups: *ad libitum* (2850 kcal ME/kg of ration and 20% of crude protein from 1 to 21 days and 3040 kcal ME/kg and 17% of crude protein from 22 to 42 days) or energy restricted (2565 kcal ME/kg and 20% of crude protein) or protein restricted (2850 kcal ME/kg and 15% of crude protein). Feed restriction was applied during the second week post-hatching (8-14 days). Before and after the feed restriction period, the birds were fed *ad libitum* with control diets until the end of the experiment (42 days). Feed was continuously available to the animals in the *ad libitum* group. The rations used in the experiment were based on corn and soybean meal. On the 14th, 21st, 28th and 42nd days of age, eight chickens of each treatment were weight and then sacrificed to determine the chemical carcass composition (ether extract, protein and ash). The whole carcasses, including the feathers, were grind in an industrial meat grinder (C.A.F. cutter of meat - FB - 09/93), samples where then dried in greenhouses with forced ventilation at 55°C for 72 hours and, later triturated in knife mill. The ether extract, protein and ash determination had been done in accordance with Association of Official Analytical Chemistry - AOAC (1975). For each temperature, a split-plot design was used with the feed program (control, energy or protein restriction) as the main plot and age as the sub-plot. Data were subjected to statistical analysis using the General Linear Model procedure (GLM) of SAS (SAS Institute, 1998). Differences between means were tested using Tukey test.

Results and Discussion

The results (Table 1) demonstrate that by the end of restriction period (14^{th} day) there was a carcass fat reduction in birds kept at 18°C and 25°C, but not on birds reared at 33°C. However, it was not observed differences ($P>0.05$) in the chemical carcass composition for the ether extract among the different treatments at 42 days of age. Similar results were obtained by FURLAN (1996) that observed carcass fat reduction only during the feed restriction period. These findings suggest that during refeeding period, the chicken looks to restitute the energy used during feed restriction, making fat deposition in the adipocyte. However, JONES & FARREL (1992) reported a decrease in carcass fat on broilers chickens submitted to qualitative feed restriction. It was observed that after the restriction period (14th day) the carcass protein content reduced, showing a mobilization of this substratum in the animals submitted to protein restriction when compared with the energy restricted ones, independently of ambient temperature. However, two weeks after the refeeding period (28 days), there were no significant differences between the treatments. These findings show that early qualitative feed restriction, didn't change significantly the bird carcass protein . WALDROUP et al. (1976), using qualitative energy and protein restrictions programs, also shown the viability of the such programs in broiler nutrition. The qualitative feed restriction (energy or protein) did not change the broiler carcass ash, independently of reared temperature. SARTORI et al. (1997), working with late feed restriction observed an increase in the ash levels on broiler chest and tights. Our results showed that the early qualitative feed restriction used was not enough to change the broiler carcass ash.

Conclusions

The results showed that, irrespective of ambient temperature, the early qualitative energy or protein restriction did not affect the carcass composition of broiler chickens at 42 days of age.

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Table 1 - Carcass composition of broiler chickens. Each value represents means ± SEM

Temperature	Treatment	Age (days)			
		14	21	28	42
		Ether extract (%)			
18°C	C[2]	30.0 ± 0.9 b[1]	33.5 ± 1.3 a	35.7 ± 1.1 a	40.6 ± 1.4 a
	RE[3]	28.8 ± 1.7 b	31.3 ± 1.0 a	32.4 ± 1.2 a	37.1 ± 1.0 a
	RP[4]	34.8 ± 1.0 a	35.3 ± 2.8 a	34.9 ± 0.6 a	38.0 ± 1.4 a
	CV (%)[5]	11.33	15.84	8.04	9.43
25°C	C	32.5 ± 1.4 b	38.1 ± 2.9 a	39.3 ± 0.6 a	40.7 ± 1.1 a
	RE	31.9 ± 1.0 b	39.2 ± 1.1 a	38.1 ± 1.0 a	42.3 ± 0.6 a
	RP	39.7 ± 0.9 a	39.6 ± 1.2 a	40.5 ± 0.7 a	41.4 ± 1.1 a
	CV (%)	8,99	13,99	6,26	6,58
33°C	C	34.9 ± 1.6 a	41.1 ± 4.0 a	37.5 ± 0.7 a	41.7 ± 1.1 a
	RE	36.6 ± 2.6 a	35.4 ± 0.6 a	37.4 ± 0.7 a	42.4 ± 1.1 a
	RP	40.6 ± 0.9 a	37.9 ± 1.0 a	39.2 ± 1.3 a	43.7 ± 1.7 a
	CV (%)	13.81	17.73	6.77	8.80
		Protein (%)			
18°C	C	51.1 ± 0.8 a	51.2 ± 0.9 b	47.8 ± 0.6 a	44.1 ± 1.3 a
	RE	50.7 ± 1.4 a	54.2 ± 0.8 a	50.4 ± 1.0 a	46.4 ± 0.6 a
	RP	47.5 ± 0.9 a	49.1 ± 0.7 b	48.9 ± 0.9 a	46.3 ± 1.1 a
	CV (%)	5.91	4.36	4.80	6.68
25°C	C	49.6 ± 0.6 a	50.2 ± 0.9 a	46.5 ± 0.8 a	45.1 ± 0.7 a
	RE	49.8 ± 1.6 a	48.6 ± 1.3 a	47.4 ± 0.6 a	43.7 ± 0.8 a
	RP	42.2 ± 0.6 b	49.4 ± 1.2 a	46.2 ± 0.4 a	42.7 ± 0.9 a
	CV (%)	6.20	6.52	6.58	6.11
33°C	C	47.9± 0.8 ab	49.1 ± 0.8 a	47.5 ± 0.7 a	45.1 ± 0.7 a
	RE	48.6 ± 1.4 a	49.8 ± 0.8 a	48.3 ± 0.7 a	44.1 ± 0.9 a
	RP	44.7 ± 0.9 b	47.3 ± 1.0 a	46.1 ± 0.6 a	2.5 ±1.7 a
	CV (%)	6.25	4.98	3.90	6.00
		Ash (%)			
18°C	C	8.9 ± 0.3 a	8.0 ± 0.3 a	7.9 ± 0.2 b	7.2 ± 0.3 a
	RE	9.0 ± 0.3 a	8.0 ± 0.3 a	9.1 ± 0.3 a	7.9 ± 0.3 a
	RP	8.6 ± 0.2 a	8.4 ± 0.4 a	8.1 ± 0.3 b	7.1 ± 0.2 a
	CV (%)	8.31	10.60	9.55	10.14
25°C	C	8.6 ± 0.3 a	8.6 ± 0.5 a	7.1 ± 0.3 a	7.5 ± 0.3 a
	RE	8.7 ± 0.2 a	7.6 ± 0.4 a	8.0 ± 0.3 a	7.1 ± 0.4 a
	RP	8.0 ± 0.3 a	7.6 ± 0.3 a	7.8 ± 0.3 a	7.2 ± 0.3 a
	CV (%)	9.89	13.89	11.36	13.08
33°C	C	8.5 ± 0.3 a	7.3 ± 0.3 a	8.2 ± 0.4 a	6.9 ± 0.2 a
	RE	8.3 ± 0.3 a	7.5 ± 0.3 a	7.9 ± 0.2 a	6.8 ± 0.2 a
	RP	7.8 ± 0.2 a	7.1 ± 0.2 a	7.9 ± 0.4 a	6.5 ± 0.2 a
	CV (%)	8.61	10.15	11.62	9.55

[1] Means within a column for each temperature followed by different letters differ ($P<0.05$) by Tukey test; [2] Control group; [3] Energy restriction; [4] Protein restriction; [5] Coefficient of variation.