Comparative Rates of Fat Deposition in Two Strains of Broiler Cockerels

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Introduction

In previous work (Chambers et al., 1981), carcass composition differences were observed among genetic groups of broilers slaughtered at 47 days of age. Modern stocks of broilers grew much more rapidly and had more carcass and abdominal fat than a strain of broilers representing chickens of the mid-fifties. Comparisons based on age favour slower growing broilers because they are smaller and contain less fat than they would if compared at the same weight.

Modern broilers are reputed to contain excessive fat, particularly abdominal fat, when compared with broilers of earlier years. This excessive fat is wasteful and has become a major concern not only of the processing and fast food sectors of the broiler industry but also of the consumer.

In this study, carcass composition of two strains of broilers representing two eras 25 years apart was determined. Strains were compared at similar chronological age and at similar carcass weights. Patterns of fat deposition were also investigated and compared to determine whether the modern broiler, the product of intesne selection for faster growth and of improved management practices, differs in its composition due to a more rapid rate of fat deposition or simply to faster growth and, hence, has more fat at an earlier age.

Materials and Methods.

Broiler cockerels of two strains were slaughtered serially at two week intervals between one and 17 weeks of age (Table 1). The Ottawa Meat Control Strain (Strain K) represented broilers of the mid-fifties. It was synthesized from four lines, three commercial and one experimental, obtained in 1955 and has been maintained since then without artificial selection (Merritt and Gowe, 1962). The modern broiler was represented by a new strain (Strain 30) synthesized from seven commercial broiler dam stocks obtained by the Animal Research Centre in 1978 (Chambers et al., 1984).

All chicks (53 Strain K and 52 Strain 30) were hatched and reared simultaneously using modern practices. Initially they were fed a starter ration (23.5% CP and 13.2 MJ ME/kg) and subsequently a finisher ration (20.8% CP and 13.4 MJ ME/kg). Strain 30 was switched to the finisher ration at four weeks of age, two weeks earlier than Strain K. The change in rations was believed to occur at the same stage of development for the two strains as estimated by body weight at the change relative to mature body weight.

Following an overnight fast, each broiler was weighed, bled, scalded, plucked by hand and then weighed again (New York dressed weight). Abdominal fat consisting of gizzard and leaf fat, was separated from the eviscerated carcass and its weight recorded. The eviscerated carcass was separated as described by Fortin and Chambers (1981) into legs, wings, breast and back which collectively define the carcass. The carcass was then prepared for determination of chemical fat (36 hours anhydrous petroleum extraction - Fortin and Chambers, 1981).

The rates of deposition of chemical fat and abdominal fat relative to the weight of the carcass were calculated using the allometric function $Y = aX^b$ where Y is the weight of fat, X the weight of carcass, b relative rate of deposition and a is a constant. The parameters, b and a, were estimated by least squares after a log-log transformation of the allometric function (SAS, 1982).

Results.

Mean carcass weights, number, age at slaughter and the proportions (%) of chemical fat and abdominal fat are presented in Table 1 for each strain - slaughter age subclass.

Strain comparisons at common slaughter age show that Strain 30 broilers had higher percentages of chemical and abdominal fat than Strain K. Figure 1 further illustrate the compositional differences associated with chronological age comparisons. The rates of deposition of chemical fat and abdominal fat relative to carcass weight are shown in Table 2 for each strain.

The slopes (b) and the intercepts (a) of the chemical fat growth curves of the two strains did not differ (P>0.05). Hence, at given carcass weight, chemical fat levels of the carcasses of the two strains did not differ significantly. Figure 2 illustrates the very small magnitude of these differences (approx. 40 g/1600 g carcass). Strains did differ ($P \leq 0.01$) in rate of deposition of abdominal fat not only in slope, Strain K greater than Strain 30, but also in intercept, Strain K smaller. Figure 2 also illustrates that Strain 30 had more abdominal fat at carcass weights below 920 g and less abdominal fat than Strain K at heavier carcass weight. On the other hand, the difference at any given carcass weight never exceeded 10 g or 0.7 per cent of the carcass. Furthermore, within the common 900 - 1400 g carcass weight slaughter range, Strain 30 contained at most 7 g of abdominal fat (0.5% of the carcass) and 30 g of chemical fat (1.9% of the carcass).

Discussion

Rearing broilers of the two strains using only current production practices prohibits assessment of the effect of improved rearing conditions during the past 25 years on carcass composition. Hence any differences observed in composition are due to genetic changes in the modern broiler during the last quarter century.

The modern broiler cockerel was heavier, contained more chemical fat in the carcass and had more abdominal fat than the broiler cockerel of the mid-fifties. However, these comparisons based on chronological age are misleading. Comparison at a common carcass weight gives a better assessment of composition differences. In the current study, such comparison practically eliminated all strain differences evident from comparisons based on chronological age. Furthermore, the 25 years of genetic change increased growth rate, did not alter the relative rat of chemical fat deposition in the carcass but appeared to have reduced the relative rate of abdominal fat deposition. Nevertheless, within the normal 900 - 1400 g carcass weight slaughter range, differences between strains in chemical fat and abdominal fat contents of the carcass were very small.

It appears that criticism of the modern broiler concerning excessive fatness is due to a failure to made comparisons at common carcass weights. In addition, changes in rearing conditions could also have contributed to excessive fatness; however, due to the design of this research, these effects could not be evaluated.

References.

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Table 1. Age at slaughter, number, mean carcass weight and percentages of chemical and abdominal fat for each strain slaughter-age sub class.

Strain	Number	Age at slaughter (Wk)	Carcass weight (g)	Fat (%)[1] Chemical	Abdominal
K	6	1	34	11.4	0.3
	3	3	120	11.0	1.3
	5	5	249	8.0	1.4
	7	7	511	9.5	1.9
	7	9	691	9.3	2.1
	5	10	928	11.3	3.0
	4	11	940	10.2	3.4
	4	13	1143	14.5	5.8
	6	15	1665	16.4	5.4
	6	17	1897	15.2	6.7
30	5	1	53	12.6	1.0
	6	3	257	11.0	2.1
	5	5	589	13.2	5.6
	8	6	992	13.9	3.6
	4	7	1121	15.8	4.4
	3	9	1754	14.4	2.9
	5	11	2313	16.7	4.1
	6	13	2939	16.7	6.6
	5	15	3289	18.7	6.6
	4	17	3600	19.6	6.6

[1]As a percentage of carcass weight

Table 2 Allometric relationship between weight of fat and weight of carcass for each strain[1]

	Strain	Intercept	Slope[2] (Standard error)	Effect of strain[3] Intercept	Slope
Chemical fat	K	- 1.19	1.08(0.027)**	NS	NS
	30	- 1.15	1.10(0.026)**		
Abdominal fat	K	- 3.75	1.76(0.061)**	**	**
	30	- 2.51	1.35(0.060)**		

[1]$\log_{10} Y = \log_{10} a + b \log_{10} X$; Y = weight of fat (g), X = weight of carcass (g)

[2]b>1 ; P<0.01

3 ** P<0.01 ; NS P<0.05

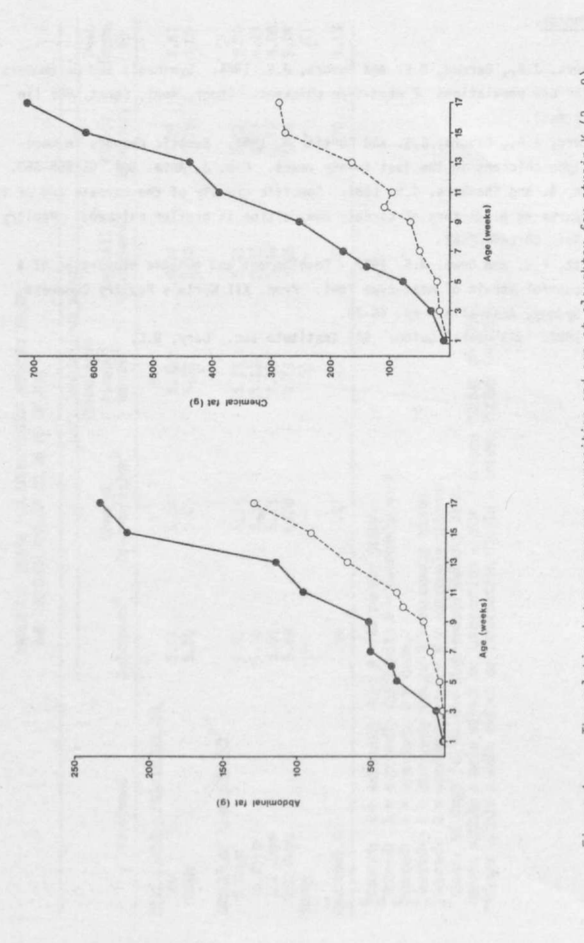

Figure 1. The relation between carcass composition and age at slaughter for strain K (O—O) and strain 30 (●—●)

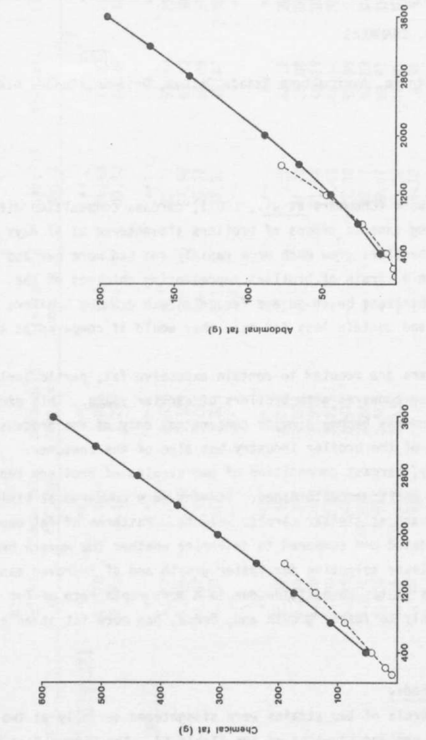

Figure 2. The relation between carcass composition and carcass weight for strain K (O—O) and strain 30 (●—●)