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PASTURE TYPE AND LAMB CARCASS COMPOSITION

A Comparison of Experimental Design

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SUMMARY

In two experiments 50 wether lambs were grazed on either lucerne or perennial ryegrass and slaughtered. In Exp. 1 the lambs were killed at the same age (age constant-weight variable data) and in Exp. 2 at predetermined liveweights to give pairs of carcasses, one from each pasture treatment, over a range of carcass weights (age variable-weight constant data). The gross chemical composition was determined on a half carcass of each lamb.

The results from each experiment were analysed by covariance analysis with the data expressed both in the arithmetic and logarithmic form. No significant effect of pasture type on carcass composition was detected.

It is concluded that the carcass composition of a given breed of lamb, growing at different rates on different pasture species, is independent of the nutritional environment. Possible explanations of the variation in conformation of lambs, which were similar in carcass composition, are briefly discussed.

LAMBS which fail to attain "prime" condition off their mothers are normally weaned, and grazed on various types of pasture until they reach a saleable condition. Therefore, it is important to know whether the type of pasture has any effect on the composition of the marketable carcass. This makes necessary group comparisons of the composition of animals which ideally should be made with *age* and *weight* constant data. However, under *ad libitum* feeding, it is impossible to obtain both in the one experiment, unless the variability in liveweight gain is very high or if the pastures being examined differ little in quality. Since lambs grow significantly faster on some pastures than on others (McLean *et al.*, 1962; Johns *et al.*, 1963) the latter situation does not always hold.

A further problem arises owing to the differential growth of body components. The use of results expressed in terms of percentages or ratios may be misleading with groups of animals grown at different rates (Miller and Weil, 1963). For example, a different proportion of any one body component in a particular group of animals may reflect either their dietary treatment or their body size or a combination of both. With some components it may reflect the chronological age of the animal.

This paper presents the results from two experiments of different design where the chemical composition of the carcasses of groups of lambs, grazed on either lucerne (*Medicago sativa*) or perennial ryegrass (*Lolium perenne*) after weaning, were determined.

MATERIAL AND METHODS

In two experiments, lambs weaned at eight weeks of age were randomized into two equal groups. One group was grazed on lucerne and the other on perennial ryegrass. In neither trial was intake limited by the quantity of feed available. Twenty-eight wether lambs [(Border Leicester ♂ × Corriedale ♀) × Dorset Down ♂] were used in Experiment 1 and 22 Romney wether lambs were used in Experiment 2. Lambs grazing lucerne grew almost twice as fast as those given perennial ryegrass.

Lambs in Exp. 1 were all slaughtered after seven weeks on their respective treatment while those in Exp. 2 were serially slaughtered when they reached a specific weight. Thus, data in two forms were obtained when the chemical composition of the minced half carcasses was determined. Experiment 1 provided age constant-weight variable data and Exp. 2, age variable-weight constant data. The two sets of data are illustrated in Fig. 1 which shows for example the logarithmic relationship between the weight of carcass fat and the carcass weight of lambs from both experiments.

The data in Fig. 1 suggest that regression analysis would be the most suitable statistical method for revealing whether pasture type had an effect on the carcass composition (Seebeck, 1968). Accordingly, analysis of covariance was used to assess group differences in terms of the regression coefficient of the individual group regressions and the group means, adjusted to the geometric mean of the independent variable (carcass weight) along the slope of the common regression line (Snedecor, 1956). Statistical analysis was also carried out when the data had been transformed to logarithms (Elsley *et al.*, 1964). With this transformation the slope of the line becomes the constant differential growth ratio (Huxley, 1924) or the growth coefficient of the body component being investigated. It gives an index of the relative growth rate between a carcass component and the carcass as a whole. For example, if the slopes for the fat component differed between groups of lambs, then it might be concluded that nutritional treatment altered the pattern of metabolism, leading to different rates of fat deposition.

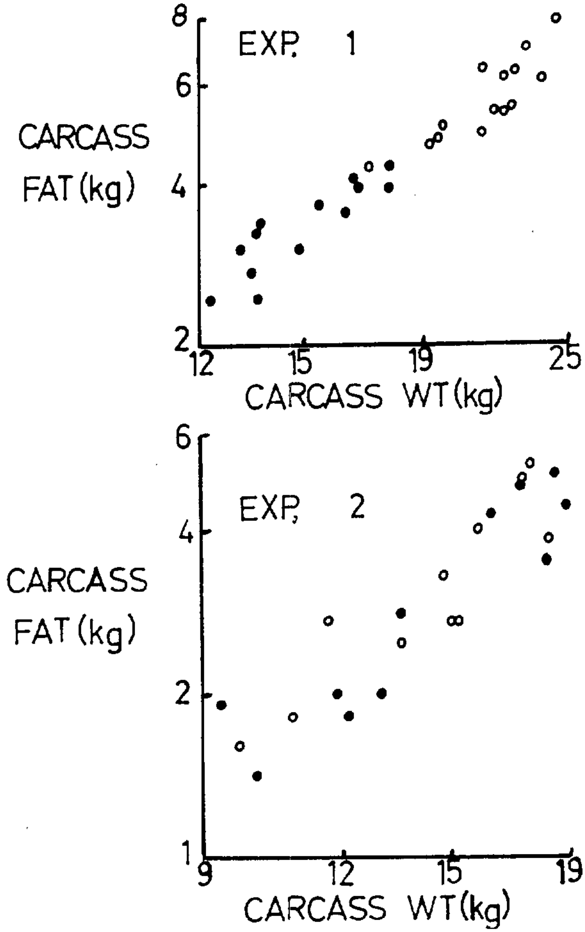

FIG. 1: *Log. fat-carcass weight relationships (● = Perennial ryegrass, O = Lucerne)*

RESULTS

The regression coefficients, adjusted means and *F* values from the analysis of covariance of the arithmetic body composition data for both experiments are given in Table 1. In arithmetic data the regression coefficients simply describe the additive rate at which a carcass component is increased. In other words, for every unit increase in total carcass weight, the component will increase in weight by its regression coefficient. None of the F values in Table 1 reached significance, which means that pasture type had no significant effect on the gross chemical composition of the carcass or the rate at which individual components were deposited.

TABLE 1: REGRESSION COEFFICIENTS, ADJUSTED MEANS AND F VALUES FOR ARITHMETIC DATA FROM EXPERIMENTS 1 AND 2

	Fat		*Protein*		*Water*		*Ash*	
	Regr. Coeff.	*Adj. Mean (kg)*	*Regr. Coeff.*	*Adj. Mean (kg)*	*Regr. Coeff.*	*Adj. Mean (kg)*	*Regr. Coeff.*	*Adj. Mean (kg)*
				EXPERIMENT 1				
PR*	0.335	4.643	0.180	2.893	0.466	10.035	0.016	0.741
LUC	0.409	4.548	0.108	2.948	0.425	10.086	0.056	0.765
F	0.52	0.07	2.49	0.09	0.26	0.02	3.12	0.05
				EXPERIMENT 2				
PR	0.363	3.092	0.163	2.400	0.440	8.413	0.033	0.571
LUC	0.367	3.198	0.145	2.437	0.448	8.285	0.039	0.561
F	0.01	0.17	0.31	0.16	0.01	0.49	0.36	0.14

*PR = perennial ryegrass, LUC = lucerne

Table 2 presents the results from the covariance analysis of the data after transformation into logarithms. With this transformation the increased quantitative variation in carcass components, with increasing carcass weight, becomes compressed, which results in the mean square deviations being more stable compared with those when arithmetic values are used. In spite of this, there was still no significant treatment effect on the relative rates of growth or the amount of any one chemical component of the lamb carcass.

The carcass compositional data from Exp. 1 were tested against those from Exp. 2, again using covariance analysis. The results are given in Table 3. The F values show there was no significant effect of the breed of lamb used in these experiments, on the chemical composition of the carcass. Single prediction equations based on carcass weight could therefore be presented for all lambs.

TABLE 2: REGRESSION COEFFICIENTS, ADJUSTED MEANS* AND F VALUES FOR LOGARITHMIC DATA FROM EXPERIMENTS 1 AND 2

	Fat		*Protein*		*Water*		*Ash*	
	Regr. Coeff.	*Adj. Mean (kg)*	*Regr. Coeff.*	*Adj. Mean (kg)*	*Regr. Coeff.*	*Adj. Mean (kg)*	*Regr. Coeff.*	*Adj. Mean (kg)*
				EXPERIMENT 1				
PR	1.508	0.642	1.101	0.446	0.817	0.996	0.422	—0.151
LUC	1.463	0.638	0.712	0.465	0.808	0.986	1.345	—0.121
F	0.01	0.01	2.17	0.01	0.01	0.01	2.83	0.38
				EXPERIMENT 2				
PR	1.727	0.451	0.980	0.369	0.766	0.919	0.845	—0.250
LUC	1.683	0.472	0.890	0.377	0.778	0.910	0.925	—0.261
F	0.01	0.41	0.29	0.23	0.01	0.72	0.14	0.28

*Adj. means are log. values

TABLE 3: REGRESSION COEFFICIENTS, ADJUSTED MEANS* AND F VALUES FOR LOGARITHMIC DATA FROM EXPERIMENTS 1 AND 2

	Regr. Coeff.			*Adj. Mean (kg)*		
	Exp. 1	*Exp. 2*	*F*	*Exp. 1*	*Exp. 2*	*F*
Fat	1.473	1.713	1.61	3.614	3.499	0.53
Protein	0.941	0.945	0.01	2.553	2.642	1.76
Water	0.816	0.769	0.71	9.016	9.032	0.03
Ash	0.942	0.875	0.13	0.656	0.618	1.87

*Adj. means are arithmetic values

The equations ($n = 50$), were:

$$\log F = 1.618 \log \mathrm{CW} - 1.394$$
$$\mathrm{RSD} = \pm 0.062,\ r = +0.94$$
$$\log P = 0.910 \log \mathrm{CW} - 0.678$$
$$\mathrm{RSD} = \pm 0.033,\ r = +0.95$$
$$\log W = 0.793 \log \mathrm{CW} + 0.003$$
$$\mathrm{RSD} = \pm 0.017,\ r = +0.98$$
$$\log A = 0.971 \log \mathrm{CW} - 1.363$$
$$\mathrm{RSD} = \pm 0.059,\ r = +0.87$$

where F = fat weight (kg), P = protein weight (kg), W = water weight (kg), A = ash weight (kg), CW = carcass weight (kg), RSD = residual standard deviation, and r = correlation coefficient.

DISCUSSION

The covariance technique for analysing the age-constant results from Exp. 1 might be criticized on the basis that the means were adjusted to a geometric mean carcass weight midway between the two groups of lambs. Furthermore, the regression coefficients may be misleading because the range of carcass weights in an individual group was smaller than that for the common regression for both groups. This was particularly noticeable when the data were transformed to logarithms because of the compression of values at the higher carcass weights. The problem was overcome with the weight-constant data in Exp. 2 although criticism here could stem from the fact there was a chronological age difference between groups of lambs. In this respect the protein content of the non-carcass component of Romney lambs given perennial ryegrass in this experiment was found to be significantly higher ($P < 0.01$) than those fed on lucerne. This would appear to be a chronological age effect brought about through wool growth as many of the lambs grown slowly were not slaughtered until the late autumn-early winter period.

The results from the present experiment suggest that the chemical composition of the lamb carcass was independent of the nutritional environment and it can be said along with Weil and Wallace (1963) that "compositional homeostasis" appeared to be the rule. However, one difference that was obtained, other than the difference in growth rate which markedly favoured the lucerne-fed lambs, was that in conformation. Carcasses from lambs given lucerne, particularly those lambs in Exp. 2, were of the "blocky-type" conformation, whilst those fed on perennial ryegrass were "leggy". In this respect the above results may conflict with those of Kirton and Pickering (1967) and Kirton (1968) who found differences in carcass composition between lambs that differed in conformation. It is probable that our lambs were genetically more similar than those in the studies just quoted. It is suggested that the differences in carcass conformation of the lambs in the present study may have been initiated by differential weight loadings (Tulloh and Romberg, 1963) on their leg bones during growth.

REFERENCES

Elsley, F. W. H.; McDonald, I.; Fowler, V. R., 1964: *Anim. Prod.*, *6*: 141.
Huxley, J. S., 1924: *Nature, Lond.*, *114*: 895.

Johns, A. T.; Ulyatt, M. J.; Glenday, A. C., 1963: *J. agric. Sci., Camb., 61*: 201.
Kirton, A. H., 1968: *Proc. Lincoln Coll. Fmrs' Conf.*: 52.
Kirton, A. H.; Pickering, F. S., 1967: *N.Z. Jl agric. Res., 10*: 183.
McLean, J. W.; Thomson, G. G.; Iversen, C. E.; Jagusch, K. T.; Lawson, B. M., 1962: *Proc. N.Z. Grassld Ass.*: 57.
Miller, I.; Weil, W. B., 1963: *Ann. N.Y. Acad. Sci., 110*: 349.
Seebeck, R. M., 1968: *Anim. Breed. Abstr., 36*: 167.
Snedecor, G. W., 1956: *Statistical Methods*, 5th ed. Iowa State University Press.
Tulloh, N. M.; Romberg, B., 1963: *Nature, Lond., 200*: 438.
Weil, W. B.; Wallace, W. M., 1963: *Ann. N.Y. Acad. Sci., 110*: 358.