INFLUENCE OF BREED AND SEX ON GROWTH PATTERNS AND LINEAR RELATIONSHIP AMONG MAJOR BOVINE TISSUES

Influence de la race et du sexe sur le rhytme de croissance et sur le rapport lineaire entre les tissus bovins majeurs

Influencia de la raza y del sexo sobre el tipo de crecimiento y la relación linear entre los tejidos bovinos mayores

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Introduction

Breed and sex differences in carcass composition have been studied by relating changes in major tissues to carcass weight (BAILEY *et al.*, 1966; BERG and BUTTERFIELD, 1968). In contrast studies have also been made to investigate treatment response on component tissues on a fat-free basis (BERG and BUTTERFIELD, 1966; MUKHOTY and BERG, 1971). The choice of different covariates has given birth to a controversial question of whether fat tissue should or should not be used as a covariate to evaluate treatment differences in carcass composition (PALSSON, 1967). The objective of the present research is (*a*) to elucidate breed and sex influence on relationships involving major bovine tissues and (*b*) to study the appropriateness of using common size dimension across breed or sex groups when three important carcass traits (muscle, muscle : bone ratio and percentage fat) are regressed, one at a time, on various control dimensions (muscle, bone, muscle plus bone, cold carcass weight).

Materials and methods

Description of animals. The animals used were representative of purebred beef, dairy breeds and crossbreds. A synthetic line, herein referred to as the Hybrid line, was developed from the Charolais, Angus and Galloway breeds. In referring to crossbreds, the breed of sire is listed first with the breed of dam

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following; when a cross involves one sire breed and several dam breeds, only the sire breed is listed, e.g. Shorthorn cross or Brown Swiss cross. The Shorthorn cross group was a mixture of beef bred crosses whereas the Brown Swiss cross was a mixture of dairy-beef crosses. Management and feeding followed commercial practices (BERG and McELROY, 1968).

Dissection technique. The total anatomical dissection technique described by BUTTERFIELD and MAY (1965) was used. A detailed description of the slaughter plan and principles of dissection were described by MUKHOTY and BERG (1971).

Statistical analysis. The statistical procedures were adapted from BANCROFT (1968) and WILLIAMS (1959). One-way analysis of covariance was used to examine breed and sex differences in muscle, muscle : bone ratio and percent fat when muscle, bone, muscle plus bone and cold carcass weight were held, one at a time, to a constant level, i.e. overall mean of breed or sex. Pooled regression coefficients were used to estimate adjusted means when slopes were found homogeneous across breed-sex groups and breed or sex regressions were used to estimate adjusted means where the slopes were found heterogeneous. Only linear relationships and adjustments were used.

RESULTS AND DISCUSSION

Breed effects. In Table 1 the important carcass compostion traits (total muscle, muscle : bone ratio and percentage fat) are regressed on various size dimensions (muscle, bone, muscle plus bone and cold carcass weight). Breed groups of bulls, steers and heifers differed ($P < 0.01$) in regressions of muscle on bone or on cold carcass weight indicating breed divergence in the rate of muscle deposition relative to bone or cold carcass weight increases. Since these regressions differed, adjustment of muscle weight was not legitimate when using bone or cold carcass weight as control dimensions. However, within all three sexes the regression of muscle on muscle plus bone showed no differences among breeds indicating that the rate of muscle deposition relative to changes in muscle plus bone did not differ significantly among breed groups. It was therefore possible to adjust breed group muscle weight to common muscle plus bone levels and to compare breed groups for muscle weights so adjusted. This relationship represents a large part to whole component which would tend to make the group regressions more similar. However, after adjusting total muscle to common muscle plus bone levels, breed differences in total muscle were significant. Similar results were found by BERG and BUTTERFIELD (1966) over this relationship with respect to steers. In bulls Jersey- and Shorthorn-crosses had the most muscle when adjusted to a common muscle plus bone weight and Holstein had the least. In steers Holstein- and Brown Swiss-crosses had the least muscle at a given muscle plus bone weight.

Breed groups of bulls, steers and heifers differed ($P < 0.01$ or $P < 0.05$) in regressions of muscle : bone ratio on bone (Table 1). The inference is that bone cannot be used as a common dimension for testing breed variations in muscle : bone ratio. However, muscle : bone ratio regressed on muscle, muscle plus bone and cold carcass weight showed homogeneity among breed groups indicating the appropriateness of using any one of these covariates as common dimensions. Breed groups within sexes differed significantly ($P < 0.01$ or $P < 0.05$) in muscle: bone ratio adjusted to common muscle, muscle plus bone or cold carcass weight. This also supports the findings of BERG and BUTTERFIELD (1966) with respect to steers. Muscle : bone ratio could differ among breeds because of differences in relative growth rates of muscle and bone over the period represented in the present study or differences could have been established at some earlier stage. MUKHOTY and BERG (1971) suggested the latter since the growth coefficients for muscle and bone did not differ significantly among breed groups but adjusted muscle and bone levels did. Their result could have been influenced by the large part to whole relationships in muscle to muscle plus bone. The present study, where groups differ in the regression of muscle on bone would support the concept that differential growth of muscle and bone was continuing among breed groups over the weight range of the present data. In bulls Holstein had the lowest muscle : bone ratios adjusted for muscle plus bone weight and in steers Brown Swiss crosses and Holstein were lower in adjusted muscle : bone ratio than the other breed groups.

Breed groups of bulls, steers and heifers differed ($P < 0.01$ or $P < 0.05$) in regressions of percentage fat on muscle and cold carcass weight reflecting a significant breed variation in the rate of fattening in relation to muscle or cold carcass weight. This would also mean that muscle or carcass weight could not be used as common size dimensions for breed differences in percent fat. No significant differences were observed among breed groups within sex for regressions of percentage fat on bone or muscle plus bone indicating the appropriateness of using bone and muscle plus bone as common size dimensions to study breed variation in percentage fat in the carcass. Breed differences were significant in percentage fat after adjusting to common bone or muscle plus bone weights. Holstein bulls had the lowest percentage of fat on an adjusted basis. Brown Swiss cross steers and Holstein steers were similar to Hereford × Hybrid crosses for adjusted fat percentages and these three groups had lower adjusted fat percentages than the other groups.

Sex effect. In Table 2 sexes are compared for total muscle, muscle: bone ratio and percentage fat when adjusted by covariance to a common size dimension (muscle, bone, muscle plus bone or cold carcass weight). In all sex within breed group comparisons, the regressions of muscle on bone differed among sexes, reflecting a divergence in muscle deposition relative to bone among sexes. This would also mean that bone cannot be used as common size dimension for comparing total muscle among sex groups. The regressions of muscle on muscle plus bone or on cold carcass weight were homogeneous for each sex within breed group comparisons. The inference is that common muscle plus bone or cold carcass weight could be used as covariates for comparing sex differences in total muscle. There was no significant sex difference in muscle adjusted to common muscle plus bone weights. MUKHOTY and BERG (1971) also reported that at equal muscle plus bone weights sexes did not significantly differ in muscle content. However, when muscle was adjusted to cold carcass weights, significant sex differences in muscle weight were obtained within every breed group.

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ADJUSTED MEANS (y') AND REGRESSION COEFFICIENTS (b) WITH TOTAL MUSCLE WEIGHT, MUSCLE
DATA FROM DIFFERENT BREED

Sex	Breed	Number of animals	Age days	Live weight Kg		Total muscle weight: Bone	Muscle + bone	Cold carcass weight
		Independent variables				*Dependent variables*		
Bulls	Hereford	13	461	466	b	5.17	0.87	0.79
					y'	81.56	77.90 [c]	73.47
	Hybrid[2]	17	443	497	b	6.65	0.91	0.71
					y'	84.83	77.67 [c]	83.56
	Hybrid × Hereford	5	388	470	b	4.68	0.88	0.41
					y'	72.44	76.53 [d]	73.65
	Shorthorn cross	12	361	386	b	6.47	0.89	0.46
					y'	82.72	78.12 [a]	80.31
	Holstein	8	386	416	b	2.48	0.77	0.57
					y'	59.06	74.74 [e]	81.47
	Jersey	8	407	294	b	5.93	0.38	0.51
					y'	75.95	78.36 [a]	72.24
	Variance ratio:							
	Between slopes[1]					5.67 **	1.27	4.21 **
	Between intercepts					—	18.01 **	—
Steers	Hereford	11	402	374	b	4.22	0.85	0.41
					y'	72.12	70.64 [a]	65.63
	Hybrid	16	433	462	b	3.10	0.84	0.39
					y'	69.93	69.73 [c]	69.04
	Hereford × Hybrid	8	441	434	b	1.70	0.82	0.47
					y'	69.98	69.78 [c]	72.23
	Hybrid × Hereford	16	434	462	b	4.65	0.85	0.41
					y'	71.37	69.97 [c]	70.12
	Hereford × (A. G.)[3]	13	425	439	b	2.56	0.93	0.27
					y'	72.50	70.35 [a]	68.56
	Shorthorn cross	22	383	377	b	6.06	0.86	0.44
					y'	71.88	70.59 [a]	69.10
	Brown Swiss cross	14	404	457	b	4.41	0.85	0.57
					y'	64.76	68.68 [d]	73.70
	Holstein	6	480	467	b	1.44	0.93	0.30
					y'	60.38	67.89 [e]	72.83
	Variance ratio:							
	Between slopes[1]					4.70 **	0.956	2.81 **
	Between intercepts					—	11.48 **	—
Heifers	Hereford	10	365	306	b	4.12	0.84	0.34
					y'	51.57	51.80	52.21
	Shorthorn cross	12	398	346	b	5.01	0.85	0.43
					y'	51.93	50.73	51.39
	Variance ratio:							
	Between slopes[1]					4.55 *	0.08	9.27 **
	Between intercepts					—	4.50 *	—

* Significant at ($P < 0.05$).
** Significant at ($P < 0.01$).
— Missing values indicate analyses of covariance and comparisons of adjustec
acdef Adjusted means having different superscript in a column differ significant
1 Degrees of freedom are 5 and 51 in bulls, 7 and 90 in steers and 1 and 18 ir
y' indicates independent variable adjusted to overall mean of × (muscle = 78.3
cold carcass weights = 121.85, 119.54, 92.47 Kg in bulls, steers and heifers respectively
2 Hybrid refers to a synthetic line developed from Charolais, Angus and Gallowa
3 (A. G.) signifies Angus × Galloway.

E 1

NE RATIO AND PERCENTAGE FAT AS DEPENDENT VARIABLES BASED ON THE HALF CARCASS DISSECTION
F BULLS, STEERS AND HEIFERS

Muscle: bone ratio				Percentage fat			
Muscle	Bone	Muscle + bone	Cold carcass weight	Muscle	Bone	Muscle + bone	Cold carcass weight
0.02	0.011	0.014	0.005	0.26	1.18	0.18	0.20
5.19 [a]	5.28	5.20 [a]	5.11 [a]	27.24	27.41 [a]	27.24 [a]	26.36
0.03	0.087	0.024	0.016	0.08	0.27	0.05	0.01
5.07 [a]	5.40	5.09 [a]	5.27 [a]	22.22	20.31 [e]	21.69 [e]	19.29
0.02	0.001	0.018	0.005	0.30	2.56	0.29	0.12
4.71 [c]	4.69	4.69 [c]	4.64 [c]	25.98	25.35 [c]	25.95 [c]	25.08
0.021	0.121	0.018	0.012	0.10	0.72	0.08	0.05
5.23 [a]	5.19	5.23 [a]	5.23 [a]	21.35	21.94 [e]	21.36 [e]	22.13
0.03	0.890	0.008	0.021	0.09	0.06	0.06	0.08
4.20 [e]	3.95	4.14 [e]	4.29 [c]	13.63	12.05 [d]	13.48 [d]	14.29
0.04	0.147	0.034	0.023	0.01	— 0.17	0.11	0.28
5.12 [a]	4.77	5.11 [a]	4.96 [a]	20.59	21.71 [e]	20.26 [e]	22.73
0.56	4.45 **	0.66	0.94	3.55 **	1.83	2.15	3.62 **
14.49 **	—	14.62 **	9.25 **	—	11.82 **	3.57 **	—
0.01	0.020	0.011	0.002	0.28	1.55	0.25	0.23
5.04 [a]	4.90	5.03 [a]	4.95 [a]	29.83	29.44	29.81 [a]	30.47
0.01	0.096	0.006	0.005	0.09	0.32	0.09	0.19
4.63 [a]	4.69	4.64 [a]	4.62 [a]	31.28	31.45 [a]	31.30 [a]	30.34
0.03	— 0.16	0.004	0.012	0.28	— 0.45	0.17	0.24
4.67 [a]	4.71	4.77 [a]	4.71 [a]	25.68	25.79 [c]	25.69 [c]	25.72
0.01	0.004	0.009	0.002	0.45	1.95	0.38	0.18
4.70 [a]	4.78	4.71 [a]	4.70 [a]	30.68	30.86 [a]	30.70 [a]	29.89
0.05	— 0.17	0.041	0.013	0.03	— 1.17	0.01	0.35
4.86 [a]	4.88	4.87 [a]	4.84 [a]	30.72	30.71 [a]	30.74 [a]	30.34
0.021	0.112	0.018	0.008	0.13	0.75	0.11	0.07
4.97 [a]	4.84	4.96 [a]	4.95 [a]	28.70	28.27 [a]	28.63 [a]	30.15
0.02	0.010	0.012	0.008	0.01	0.04	0.01	0.06
4.27 [c]	4.36	4.26 [c]	4.35 [c]	24.42	24.73 [c]	24.42 [c]	24.14
0.02	0.141	0.022	0.012	0.08	0.10	0.08	0.07
4.04 [c]	4.11	4.02 [c]	4.09 [c]	24.75	25.09 [c]	24.72 [c]	24.32
0.77	4.59 **	0.96	0.41	2.81 **	1.88	2.03	2.89 **
12.91 **	—	11.26 **	9.15 **	—	4.24 **	3.01 **	—
0.02	0.040	0.010	0.011	0.31	1.65	0.27	0.29
4.95	4.90	4.94	4.95	31.03	30.87	31.02	31.30
0.019	0.101	0.015	0.006	0.32	0.91	0.27	0.15
4.78	4.91	4.78	4.77	30.69	30.82	30.69	30.46
0.02	4.57 *	0.03	0.09	8.47 **	1.66	1.88	16.20 **
5.62 *	—	4.98 *	5.32 *	—	4.56 *	4.51 *	—

eans not legitimate.
t ($P < 0.01$ or $P < 0.05$).
ifers.
88, 51.76 Kg; bone = 15.45, 14.92, 10.55 Kg; muscle plus bone = 92.87, 84.79, 62.37 Kg and

eeds.

TABLE 2

Among sex group comparisons of adjusted means (y') and regression coeficients (b) with total muscle weight, muscle: bone ratio and percentage fat as dependent variables in five different breeds

Dependent variables			Total muscle weight			Muscle: bone ratio				Percentage fat			
Independent variables: Breed	Sex		Bone	Muscle + bone	Cold carcass weight	Muscle	Bone	Muscle + bone	Cold carcass weight	Muscle	Bone	Muscle + bone	Cold carcass weight
Hereford	Bulls.	b	5.17	0.87	0.79	0.02	0.011	0.014	0.005	0.26	1.18	0.18	0.20
		y'	69.44	65.41	70.85 [a]	5.16	5.35	5.12	5.14	25.34 [a]	26.30 [a]	25.01 [a]	22.80 [a]
	Steers.	b	4.22	0.85	0.41	0.01	0.020	0.011	0.002	0.28	1.55	0.25	0.23
		y'	62.66	65.20	63.40 [c]	5.01	4.86	5.06	5.03	29.98 [c]	29.62 [c]	30.00 [c]	30.35 [c]
	Heifers.	b	4.12	0.84	0.34	0.02	0.040	0.010	0.011	0.31	1.65	0.27	0.29
		y'	62.32	64.83	59.67 [e]	4.94	4.80	4.92	4.90	32.49 [e]	31.64 [e]	32.10 [e]	35.39 [e]
Variance ratio:													
Between slopes...			4.97 *	0.83	1.21	5.67 **	4.57 *	0.35	0.14	2.55	3.14	1.90	3.01
Between intercepts ..			—	2.18	6.71 **	—	—	1.47	1.79	5.72 **	6.74 **	5.05 *	6.30 **
Hybrid	Bulls.	b	6.65	0.91	0.71	0.03	0.087	0.024	0.016	0.08	0.27	0.05	0.01
		y'	91.70	84.43	92.24	5.21	5.52	5.24	5.56	21.52	22.44	22.91	20.64
	Steers.	b	3.10	0.84	0.39	0.01	0.096	0.006	0.005	0.09	0.32	0.09	0.19
		y'	77.84	83.64	77.27	4.97	4.72	4.94	4.78	30.86	31.19	30.69	31.78
Variance ratio:													
Between slopes...			5.07 *	3.03	1.32	4.21 *	4.13 *	2.09	2.05	1.05	0.02	0.84	1.20
Between intercepts ...			—	2.23	10.69 **	—	—	2.90	3.30	19.42 **	19.51 **	12.03 **	20.21 **
Hybrid × Hereford	Bulls.	b	4.68	0.88	0.41	0.02	0.001	0.018	0.005	0.30	2.56	0.29	0.12
		y'	77.62	75.76	79.60	4.71	4.80	4.80	4.78	27.18	26.87	27.17	25.61
	Steers.	b	4.05	0.85	0.41	0.01	0.004	0.009	0.002	0.45	1.95	0.38	0.18
		y'	76.94	75.56	74.50	4.80	4.78	4.72	4.78	30.49	30.59	30.50	30.94

Variance ratio:													
Between slopes...			6.12 *	0.50	0.34	6.22 **	5.62 *	0.48	0.12	2.34	1.56	2.10	0.14
Between intercepts ...			—	0.23	4.45 *	—	—	0.32	0.01	8.90 **	8.88 **	5.65 *	4.61 *
Shorthorn cross	Bulls.	b	6.47	0.89	0.46	0.021	0.121	0.018	0.012	0.10	0.72	0.08	0.05
		y'	65.35	62.43	70.44 [a]	5.08	5.07	5.09	5.01	19.67 [a]	20.00 [a]	19.94 [a]	20.66 [a]
	Steers.	b	6.06	0.86	0.44	0.021	0.112	0.018	0.008	0.13	0.75	0.11	0.07
		y'	63.68	62.07	62.85 [c]	4.89	4.95	4.90	4.93	28.53 [c]	28.19 [c]	28.36 [c]	28.58 [c]
	Heifers.	b	5.01	0.85	0.43	0.019	0.101	0.015	0.006	0.32	0.91	0.27	0.15
		y'	60.71	61.86	54.64 [e]	4.81	4.79	4.81	4.84	32.47 [e]	32.62 [e]	32.37 [e]	31.33 [e]
Variance ratio:													
Between slopes...			5.56 **	2.64	2.86	6.18 **	5.80 **	0.087	0.014	1.92	1.42	1.05	2.32
Between intercepts ...			—	2.68	9.44 **	—	—	2.40	0.90	10.21 **	59.71 **	20.03 **	10.45 **
Holstein	Bulls.	b	2.48	0.77	0.57	0.03	0.890	0.008	0.021	0.08	0.06	0.06	0.07
		y'	75.84	75.78	80.11	4.16	4.16	4.16	4.24	13.51	13.50	13.51	14.03
	Steers.	b	1.44	0.93	0.30	0.02	0.141	0.022	0.012	0.09	0.10	0.08	0.08
		y'	75.69	75.73	69.95	4.15	4.15	4.15	4.07	24.98	24.99	24.98	24.28
Variance ratio:													
Between slopes...			6.01 *	1.25	0.14	5.03 *	7.70 **	4.09	2.31	0.01	1.87	0.01	0.01
Between intercepts ...			—	0.90	12.43 **	—	—	0.01	1.81	23.43 **	26.55 **	12.48 **	82.88 **

* Significant at ($P < 0.05$).

** Significant at ($P < 0.01$).

— Missing values indicate analyses of covariance and comparisons of adjusted means not legitimate.

[ace] Adjusted means within breed and in a column having different superscript differ significantly at ($P < 0.01$ or $P < 0.05$). y' indicates independent variable adjusted to overall mean of x (muscle = 65.15, 62.06, 84.98, 75.71, 75.75 Kg; bone = 12.90, 12.58, 16.51, 15.83, 18.21 Kg; muscle plus bone = 78.06, 74.64, 100.51, 91.54, 93.97; cold carcass wt. = 111.66, 100.18, 139.59, 132.70, 118.25 Kg in Hereford, Hybrid, Hybrid × Hereford, Shorthorn cross and Holstein breeds respectively).

Regressions of muscle : bone ratio on muscle or bone differed among sexes within all breed groups. Regressions of muscle: bone ratio on muscle plus bone and cold carcass weight were homogeneous among sexes within each breed group. This would also mean that sex comparison within breed is legitimate on common levels of muscle plus bone or cold carcass weight but not on the basis of muscle or bone weight in carcass. When muscle : bone ratio was adjusted to equal muscle plus bone or cold carcass weights no significant sex within breed group differences remained. Therefore the most plausible conclusions is that at equal fat-free body weights, differences in the amount of muscle relative to bone were minimal.

Regressing fat on all of the control dimensions (muscle, bone, muscle plus bone and cold carcass weight) resulted in homogeneous regression coefficients among sexes within breed group in every case indicating the appropriateness of using any one of these covariates as a common dimension in sex comparison for proportion of fat in the carcass. Adjusting percentage fat to a common level of each control dimension resulted in a significant sex difference for percentage fat in all breed groups. When adjusted to common size dimension, percentage fat in bulls was always significantly less than in steers and steers had lower percentage than heifers. This agrees with the results of Mukhoty and Berg (1971) who found that growth coefficients for fat did not differ significantly among sexes. They also found that fat, adjusted for muscle plus bone weight, differed among sexes which agrees with the present study. It would seem therefore that differences in fatness among sexes are influenced more by early onset of fattening in heifers compared to steers and in steers compared to bulls, than to differences among sexes in rate of fattening.

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SUMMARY

Dissection data from 63 bulls, 106 steers and 22 heifers representing several breeds in each sex group were used to study growth patterns and linear relationships among major tissues in cattle. Breed groups differed in rate of muscle deposition relative to bone or carcass weight. Breed groups also differed in muscle adjusted by covariance to common muscle plus bone levels. The data support the concept that differential growth of muscle relative to bone among breed groups was a continuing process over the weight ranges studied. Differences among breeds remained in muscle : bone ratio after adjusting to common muscle, muscle plus bone or carcass weight. The differential rate of fattening relative to muscle or carcass weight was also significant among breed groups. Breed groups showed homogeneity in regression of fat on bone or muscle plus bone weight

and did differ in percentage fat adjusted to common level of bone or muscle plus bone.

The regressions of muscle or muscle : bone ratio on muscle plus bone and cold carcass weight were found homogeneous among sexes within breed. At equal fat-free levels sex differences in amount of muscle relative to bone were minimal. Bulls were superior to steers and steers to heifers in muscle content when carcass weight was held to a common level. The differential rate of fattening was similar among sex groups within breed in relation to muscle, bone, muscle plus bone or carcass weight. Percentage fat adjusted for common muscle, bone, muscle plus bone or carcass weight differed among sexes suggesting that these differences were brought about mainly by early onset of fattening in heifers compared to steers and in steers compared to bulls rather than in rate of fattening which did not differ significantly among sexes.

RESUME

Les résultats de la dissection de 63 taureaux, 106 bouvillons et 22 génisses de plussieurs races ont servi à l'étude des types de croissance et des relations linéaires entre les principaux tissus des bovins. Le taux de croissance des muscles par rapport aux os ou au poids de la carcasse a varié d'une race à l'autre, tout comme le poids de muscles, corrigé par covariance par rapport aux poids moyens des muscles et d'os. Les données obtenues confirment que la croissance différentielle des muscles par rapport aux os entre les races est un processus continu pour les intervalles de poids étudiés. Le rapport muscles/os présentait encore des écarts entre les races après correction en fonction du poids moyen de muscles, de muscles et d'os ou de la carcasse froide. Le rythme différentiel d'engraissement par rapport au poids des muscles ou de la carcasse était significatif entre les races. Les groupes de race manifestaient une homogénéité de régression du poids de graisse par rapport au poids d'os ou de muscles et d'os, et présentaient des écarts de pourcentage de graisse, corrigé en fonction du poids moyen d'os ou de muscles et d'os.

Les régressions du poids de muscles ou du rapport muscles/os pour le poids de muscles et d'os et le poids de la carcasse froide étaient homogènes entre les sexes, dans une même race. Pour des poids égaux exempts de graisse, les écarts entre sexes de la quantité de muscles par rapport aux os étaient insignifiants. Les taureaux étaient supérieurs aux bouvillons, et les bouvillons aux génisses pour la quantité de muscles pour un même poids de la carcasse. Le rythme différentiel d'engraissement par rapport au poids de muscles, d'os, de muscles et d'os ou de la carcasse était semblable entre les sexes d'une même race. Le pourcentage de graisse, corrigé en fonction du poids moyen de muscles, d'os, de muscles et d'os ou de la carcasse, a varié suivant les sexes, ce qui permet de supposer que ces écarts provenaient surtout de la production précoce de graisse chez les génisses en comparaison des bouvillons, et chez les bouvillons en comparaison des taureaux, plutôt que du rythme d'engraissement, qui n'a pas varié significativement suivant les sexes.

RESUMEN

Se utilizaron datos obtenidos de la disección de 63 toros, 106 novillos y 22 novillas que representaban varias razas y grupos de sexo diferente, para estudiar características de crecimiento y la relación linear entre los tejidos principales del ganado vacuno. Según la raza, los grupos presentaron diferencias en la proporción de distribución de tejido muscular relativamente al paso del tejido óseo o esqueleto. Asimismo, según sus razas, los grupos difirieron en tejido muscular medido por covarianza con las proporciones comunes de músculo más esqueleto. Los datos apoyan la suposición de que el crecimiento diferencial del tejido muscular en relación con el esqueleto, entre grupos de razas diferentes, es un proceso persistente por encima de las variaciones de peso estudiadas. Las diferencias entre las distintas razas se mantuvieron en el cociente músculo : hueso después del cálculo ajustado al peso ordinario del músculo, músculo juntamente con hueso o canal fría. También fue significativa la proporción diferencial de engorde relativamente al peso del tejido muscular y óseo, según los grupos raciales. Todos los grupos manifestaron homogeneidad en el peso regresivo de la grasa en relación con el peso del hueso o del hueso juntamente con el músculo, y difirieron en el porcentaje de grasa calculada por ajuste a la proporción común de hueso o de hueso y tejido muscular.

Entre los sexos de una misma raza se encontraron regresiones homogéneas en músculo o cociente músculo : hueso en el peso conjunto del músculo y del hueso y en la canal fría. A iguales proporciones de separación de la grasa, se encontraron diferencias mínimas entre ambos sexos, en la cantidad de tejido muscular relativamente al tejido óseo. Los toros superaron a los novillos y éstos a las novillas en contenido muscular, cuando el peso de la res muerta se mantuvo a niveles ordinarios. La proporción diferencial del engorde fue semejante entre los dos sexos de una misma raza, en relación con el peso del músculo, del hueso, y del músculo juntamente con el hueso o canal. El porcentaje de grasa, calculado por ajuste al peso ordinario del músculo, del hueso, del músculo y hueso o de la canal, difirió entre ambos sexos, sugiriendo esto que tales diferencias se debieron sobre todo al comienzo prematuro del engorde de las novillas, comparativamente con los novillos, y de éstos en comparación con los toros, más bien que a una proporción de engorde, que no difirió significativamente entre ambos sexos.

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