Heritabilities, Genetic, and Phenotypic Correlations Between Carcass and Live Animal Traits in Sheep (Project 347).

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This is part of the North-Central-50 Regional Sheep Breeding Project. This station's project was initiated to determine relationships between various carcass measurements and live animal traits, to estimate heritability of those traits and to determine how findings may be applied to selecting and breeding meat-type lambs.

Experimental Procedure

Seventy-six lambs of known breeding born in the fall of 1961 were used. They were sired by eight unrelated Suffolk rams and were out of an original flock of 100 western ewes. Live animal estimates and measurements were obtained on the rams and lambs and several carcass estimates and measurements were obtained on the lambs. Data are being processed on these lambs. The fourth lamb crop from these ewes is being slaughtered now. Data similar to those on previous lamb crops will be reported.

Also during 1962, 12 Hampshire ram, 3-month-old lambs were obtained from eight breeders. The rams were sheared, adjusted to feed and individually fed. Average daily gain and feed conversion were calculated. These rams will be bred to the original flock of 100 western ewes in the summer of 1963. As in previous years, performance and carcass data will be obtained on lambs produced.

Data on the 176 crossbred lambs produced during the two previous years by mating 19 Hampshire rams to the original flock of 100 western ewes have been analyzed. Rams were scored and corrections calculated between ram scores and lamb production and carcass traits. Lambs were sheared, measured and slaughtered when they weighed 95 to 100 pounds.

Simple correlations and heritability estimates (paternal half-sib correlations) were computed on all lamb and carcass traits studied.

Results and Discussion

Performance data on Hampshire rams to be used to breed the ewe flock in 1963 are reported in Table 46.

The relationship between ram scores indicated that in selecting for general type, most emphasis was placed on muscling, size of bone, size of leg, and weight of ram. Size of rear leg was most closely correlated with estimated muscling, and shorter legged rams were believed to be heavier boned. Weight of ram was significantly related with depth of probe of the longissimus dorsi muscle of the live ram.

Only a few traits were significantly related with lamb carcass and production traits. Shorter legged rams sired lambs with greater loin eye, $r = .48$; depth of loin eye, $r = .50$; and larger loin eye areas, $r = .35$. Depth of the longissimus dorsi probe in the ram was negatively related to market age of his lambs, $r = .60$; and lamb carcass grade, $r = .59$.

The relationship between lamb production traits and their carcass characteristics indicated that lambs heavier at birth gained faster and reached market weight at an earlier age. The carcasses from younger lambs contained less feathering and marbling and consequently graded lower. Rate of gain was positively related to carcass traits indicating leanness and bone, and negatively related to carcass traits indicating fatness, denoting that up to 100 pounds, gain is primarily due to growth rather than to fat production.

Few correlations between lamb measurements and carcass characteristics, even those that were statistically significant, were large enough to be used effectively in a selection program. However, length of rump was significantly correlated with weight of leg, .51, and weight of leg was significantly correlated with loin eye area, .39, and grams of lean in the rack, .39. Width at the second lumbar vertebra was more closely correlated to carcass characteristics, indicating fatness.

Live lamb measurements did not accurately indicate the same measurements on the carcass. The most useful lamb or carcass measurements that could be used as indicators of lean, fat, or bone in the carcass were width of loin in the lamb and carcass as an indicator of fat; circumference of forecannon in the lamb and carcass as an indicator of the amount of bone. Length of rump in the lamb and width of hind leg in the carcass were the best indicators of lean.

Feathering and marbling were significantly related to fat factors and carcass grade, which were positively related to market age. Carcass grade was positively related with fat factors in the carcass and either nonsignificantly or negatively correlated with factors indicating leanness in the carcass. Weights of leg and shoulder were positively related to increased leanness in the carcass and weights of the loin, rack, and breast were positively related to increased fatness in the carcass.

Sire effects were highly significant for birth weight, average daily gain, length of rump and forecannon, feathering and marbling score, and weight of loin. Generally, production traits were more highly heritable than lamb measurements of carcass characteristics, except length of forecannon, .51, and length of rump, .50 for the lamb; and feathering, .57, and marbling, .39 in the carcass.

Table 46

Performance data on Hampshire ram lambs to be used to breed ewe flock in 1963.

Ram no. (single unless noted)	Birth date	Birth weight, lbs.	Av. daily gain, lbs.[1]	Days on feed	Feed conversion, lbs.
1. Twin	1-24-62	7	.55	134	7.19
2. Twin	1- 9-62	10	.64	92	6.31
3.	1-31-62	12.5	.74	104	5.83
4.	1-11-62	11	.70	118	5.69
5.	1-14-62	10	.56	129	7.03
6.	1-13-62	14	.69	118	5.81
7.	1- 1-62	13	.73	82	6.30
8.	1- 4-62	9	.54	134	6.06
9.	1- 7-62	10.5	.63	134	6.14
10.	1- 9-62	13	.47	134	7.20
11. Twin	1-31-62	12	.71	100	6.09
12. Twin	1-10-62	12	.91	58	4.86

1. Lambs were fed from approximately 60 days of age until they weighed 140 pounds. Four lambs not reaching this weight were fed for 134 days.

Meat

The Relation of Feathering and Overflow Fat of Lamb Carcasses to the Grade of the Lamb, Degree of Marbling, and Market Value of the Lamb (Project 580).

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A total of 279 crossbred lambs were slaughtered over a three-year period at an approximate live weight of 90 pounds. USDA carcass grade and the various quality factors influencing grade were scored by a representative of the Federal Grading Service. The rack was dissected into fat, lean, bone, overflow and intercostal muscle. The **longissimus dorsi** and intercostal muscles were removed for fat analyses by the Modi-

fied Babcock Method. Color was determined in the **longissimus dorsi** and **rectus abdominis** with a Photovolt Reflectance Colorimeter. Loin samples were used for taste panel evaluations. Myoglobin concentration, by the Poel Cyano Method, pH, and expressible moisture, by the filter paper method, were also determined in the **longissimus dorsi, rectus abdominis,** and intercostal muscles.

Thirty-two crossbred lambs were randomly allotted to four treatments of eight lambs each in the color phase of the study. Lot 1 was the control; Lot 2 received 700 mgs. iron sulfate and 70 mgs. copper sulfate per pound of creep ration; Lot 3a, 5-cc injections of a 1:1000 solution of epinephrine hydrochloride in physiological saline at 12 and again at two hours prior to slaughter; Lot 3b, 10-cc injections of the epinephrine solution 12 and two hours prior to slaughter; Lot 4a, four lambs were exercised to near exhaustion immediately prior to slaughter on a treadmill; and in Lot 4b, four lambs were exercised to near exhaustion with a sheep dog.

Feathering accounted for between 40 and 50% of the variation in USDA grade. Conformation, fat streaking in the flank steak, fat streaking in the other flank muscles, quantity of external finish, color of lean in the flank steak, overflow fat, and kidney and pelvic fat were all significantly correlated with carcass grade. Marbling and percent fat in the **longissimus dorsi** muscle were both significantly correlated with grade.

Marbling was the best indicator of quality as evaluated by a taste panel. Feathering was not so good an indicator of quality, even though both the objective and subjective evaluations of marbling and feathering were significantly correlated. Carcass grade was more closely related to juiciness than to any other sensory factor.

Many subjective and objective quality evaluations were significantly correlated, suggesting that the use of subjective methods in carcass quality evaluation may be justified. Subjective conformation score was more closely related to the amount and proportion of fat in the carcass than the amount and proportion of lean.

Thickness of fat over the **longissimus dorsi** muscle appears to be a better indicator of the percent fat, lean, and bone in the carcass, although **longissimus dorsi** area was highly significantly correlated with weight of lean in the rack. **Longissimus dorsi** area appears to be influenced more by slaughter weight and chilled carcass weight than any of the other factors studied. Thickness of fat was observed to be highly correlated with internal and external fat deposits in the carcass.

Data from the color phase of the study indicate that color and pH of muscle tissue can be influenced by preslaughter treatments, such as subcutaneous injections of high levels of adrenalin and exhaustive exercise. Also, the maturity class may be influenced by factors other than age, such as stress conditions prior to slaughter. Although the analyses did not indicate significant treatment differences in USDA grade, the final grade was influenced by color of the tissue in some carcasses.

Feed Costs

Sorghum grain	$ 1.80 cwt.
Sorghum silage	$ 6.00 ton
Alfalfa hay	$20.00 ton
Prairie hay	$16.00 ton
Soybean meal	$ 3.80 cwt.
Cracked corn, cwt.	$ 2.15

Table 47
Chemical analysis of feeds used in beef cattle experiments.

Description	% protein (N x 6.25)	% ether extract	% crude fiber	% moisture	% ash	% N-free extract	% calcium	% phosphorus	Carotene, mcg./100 gms. (dry basis)
Sorghum silage	1.95	6.75	7.38	68.49	1.54	18.89	.....	.....	0.44
Alfalfa hay	11.98	1.19	35.67	5.60	3.11	42.05	.....	.....	2.20
Prairie hay	4.94	2.18	31.74	7.87	6.09	46.58	0.39	0.11	2.93
Prairie hay (three years old) ..	6.44	1.63	34.83	8.58	6.14	42.38	0.45	0.09	0.55
Prairie hay (some old growth present in hay)	4.94	2.18	30.73	9.75	7.13	45.27	0.41	0.11	3.43
Sorghum grain	10.56	3.23	1.85	9.35	1.71	73.30	0.03	0.30	.....
Ground sorghum grain	11.00	3.33	1.69	8.44	1.59	73.95	0.03	0.30	.....
Soybean meal	46.50	2.18	5.60	6.68	6.59	32.45	0.42	0.68	.....
Dicalcium phosphate	.....	.....	.....	.....	.....	.....	23.75	19.30	.....