PRODUCTION OF HEAVY-WEIGHT LAMBS WITH MAXIMUM USE OF FORAGE: COOKING AND SENSORY CHARACTERISTICS OF MEAT

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INTRODUCTION

Production practices can have large effects on the rates at which lambs reach optimum slaughter weight. Most producers cannot conduct the necessary tests to select the most efficient procedures. The input/output relationships for the production system are not alone sufficient to evaluate the acceptability of a given practice. Complete evaluation needs to include consideration of carcass merit and consumer acceptability of the end product. Thus, the three-year study reported below was undertaken at the Southwest Virginia Agricultural Experiment Station, Glade Spring, Virginia.

MATERIALS AND METHODS

Lambs were produced for two years in three systems, hereafter called flocks, as follows: flock 1 = fall lambing, with concentrate feeding; flock 2 = winter lambing with legume grazing; and flock 3 = spring lambing with grazing of native bluegrass-white clover pasture followed by concentrate feeding in fall for most lambs. Lambs were 3/4 Suffolk and were slaughtered at target weights of 55 kg for males and 50 kg for females. Males from flocks 2 and 3 were castrated but one half of those from flock 1 were left intact. Other details on the management systems have been reported (Notter and Umberger, 1989). The lambs were slaughtered, chilled and USDA carcass yield and quality grades were determined. Fore saddle, hind saddle, loin, kidney and pelvic fat weights were obtained. Loins were wrapped intact in freezer paper and sent to the Meat Science Research Laboratory of the USDA at Beltsville, MD for sensory evaluation by a trained taste panel as described by Cross et al., 1978 and by Berry et al., 1980.

Seven loin chops per lamb were cooked for sensory evaluation as described by AMSA and the NLSAMB, 1978. Four lamb chops/animal were cooked for Instron test measurement (Universal Instron Machine, Model #1122-), as described by Berry et al., 1981. Two animals' chops were cooked at one time on the grill. Frozen, thawed and cooked weights and cooking time were recorded. Chops were allowed to cool to room temperature in covered plates. Metal borers 1.27 cm in diameter were used to cut meat cores parallel to the muscle fibers. As many cores as possible were obtained from each chop. Cores were sheared perpendicular to muscle fibers using the Warner-Bratzler blade with crosshead speed at 250 mm/min, Berry, 1989.

RESULTS

Mean ages at slaughter were 159, 207 and 234 days for 148 lambs from Flock 1, for 172 lambs from Flock 2 and for 155 lambs from Flock 3, respectively. Least squares analyses showed flock effects - production systems - were statistically highly significant for all carcass variables. Year effects and sex effects were important in some traits, but not in all. The interaction for flock by year was important for final weight, dressing percent, quality grade, yield grade, backfat, kidney and pelvic fat percent, rib-eye area, marbling and foresaddle percent.

Flock differences in lambs' slaughter weights were highly significant ($P < 0.01$), but of small magnitude, largely because of the experimental design. Final weights of 245 ewe lambs were 49.4 kg; of 36 ram lambs were 56.9 kg; and, of 185 wethers were 52.3 kg. Large differences among flocks were seen in slaughter ages, chiefly a function of differences among the three production systems in lambing season and supplemental feeding. One key question here concerned the relative importance of differences in consumer acceptability associated with the three flocks.

Least squares means and their standard errors for all carcass variables are shown in Tables 1, 2 and 3. For example, final weights were 53.1, 50.4 and 50.9 kg for lambs from Flock 1, 2 and 3, respectively. S-1's received the most additional feed; they had the fastest growth rate, the best Quality Grades, and the most Back Fat, as would be expected. S-3's in contrast, had the slowest growth rate, lowest marbling scores, and were intermediate in Quality Grade, Back Fat and Rib Eye. Differences among flocks in the several carcass traits were largely a reflection of the large differences in slaughter age, intended to examine differences in production costs and economics.

Table 1. Variables for final weight, dressing %, USDA quality and yield grades. Least square means and standard errors.

Flock	Final Wt. Kg.		Chilled Dress %		USDA Quality Grade[a]		USDA Yield Grade[a]	
	$\bar{y}$	SE	$\bar{y}$	SE	$\bar{y}$	SE	$\bar{y}$	SE
1	53.1	0.41	47.0	0.30	10.26	0.08	3.21	0.06
2	50.4	0.34	46.6	0.25	9.63	0.07	2.83	0.05
3	50.9	0.35	45.7	0.26	9.82	0.07	3.08	0.05

[a]USDA Grade - 10 = C+; 9 = C Av.; 8 = C-; etc.

[b]USDA Yield Grade - 1 = Y.G 1.0-1.9, 2 = 2.0-2.9, 3 = 3.0-3.9, etc.

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Table 2. Variables for backfat, estimated kidney and pelvic fat %, rib eye area, marbling. Least square means and standard errors.

Flock	Backfat Cm.		Kidney/Pelvic Fat Kg		Ribeye Cm^2		Marbling[a]	
	$\bar{y}$	SE	$\bar{y}$	SE	$\bar{y}$	SE	$\bar{y}$	SE
1	.568	.017	2.91	.072	15.1	.156	5.55	.082
2	.436	.014	2.94	.060	13.8	.126	4.75	.068
3	.485	.014	3.37	.061	14.1	.130	4.47	.069

[a] 1 = Devoid, 2 = Practically devoid, 3 = Traces, 4 = Slight, 5 = small, 6 = Modest, 7 = Moderate, 8 = Slightly abundant.

Table 3. Variables for loin %, hind saddle % and fore saddle %. Least square means and standard errors.

Flock	Loin %		Hind Saddle %		Fore Saddle %	
	$\bar{y}$	SE	$\bar{y}$	SE	$\bar{y}$	SE
1	7.96	.082	49.1	.134	50.7	.135
2	7.63	.064	49.8	.111	50.2	.112
3	7.91	.062	50.5	.114	49.5	.114

Table 4 shows the relationship of USDA yield grade with the traits used to calculate it, namely backfat, kidney and pelvic fat estimate, and leg conformation score. Also shown in table 4 are the correlations of USDA quality grade with the factors that comprise it, namely carcass conformation, flank streaking, firmness, marbling and feathering, but differences among flocks in carcass maturity were neither expected nor found in these lambs. The several traits that comprise final quality grade were highly correlated with it, as follows: flank streaking, 0.63; carcass conformation, 0.60; feathering, 0.59; and firmness, 0.58. Marbling, which is not a factor in USDA quality grade, was less highly correlated with QG at 0.35, but was still statistically significant. The yield grade was correlated ($P<0.01$) to actual backfat measurement, and estimated kidney and pelvic fat percents. Actual kidney and pelvic percents were not as highly correlated with yield grade as were the estimated percents. The correlation of leg conformation with yield grade was low, negative and non-significant. This agrees well with findings of Van Stavern, 1970.

Table 4. Observed product-moment correlations of carcass traits with Yield Grade (YG) and Quality Grade (QG).

Selected Carcass Traits Components of:	Yield Grade	Quality Grade
Yield Grade		
1 - Yield Grade	1.00	0.32
2 - Back Fat	0.91	0.35
3 - Kidney/Pelvic Fat %[b]	0.51	0.12
4 - Estimated Kidney/Pelvic Fat %	0.63	0.26
5 - Leg Conformation	-0.02	0.47
Quality Grade		
6 - Quality Grade	0.32	1.00
7 - Flank Streaking	0.29	0.63
8 - Firmness	0.46	0.58
9 - Marbling[a]	0.26	0.35
10 - Feathering	0.23	0.59
11 - Carcass Conformation	0.10	0.60

[a] Marbling is not a quality grade factor.

[b] Actual % kidney/pelvic fat.

Trained panel members, 7-8 persons per panel, rated 2159 samples, in the normal range of lamb flavor, on tenderness, juiciness, connective tissue and flavor on an eight-point scale, with 1 = least desirable, to 8 = most desirable. Flock differences were statistically significant in all cases, with the following least squares means: for tenderness, 5.40, 5.37 and 5.71 for flocks 1, 2 and 3, respectively. Similarly, by flocks, for juiciness, they were 4.12, 4.07 and 3.99; for connective tissue, they were 7.91, 7.91 and 7.95; and for flavor, they were 3.78, 3.68 and 3.89, respectively. Lambs from flock 3 were rated most desirable in tenderness, connective tissue and flavor. Evidently the slower growth rates did not adversely affect these traits when followed by a short period of concentrate feeding. But, flock 3 was poorest of the three in juiciness, quite possibly because they were also lowest in marbling (see Table 2).

The atypical flavor ratings were first classified as off-flavors, which ranged from nearly acceptable to distinctly unacceptable. Seven of these were common enough to merit standard labels for use by the panel. These off-flavors, and the number of samples so identified, were: sour, 1226; bitter, 260; metallic, 532; sweet, 36; rancid, 245; putrid, 10; and salty, 192. Significant flock differences, chi-square with $P< .001$, were associated with these seven.

CONCLUSIONS

Three production systems, called flocks 1, 2 and 3, used target slaughter weights of 50 kg for females and 55 kg for males. Flock 1 lambs were slaughtered earliest, at 159d; and had the best USDA quality grades; but they also had the most backfat and least desirable USDA yield grades. Lambs from flock 2 were slaughtered at 207d; had the best yield grade and least backfat; and, they were intermediate in quality grade. Lambs from flock 3 were oldest at slaughter, 234d; they had the slowest growth rate, and the lowest marbling scores, and, they were intermediate in quality grade, yield grade and ribeye area. Despite their slow growth, the taste panel rated flock three lambs most desirable in tenderness, connective tissue amount, and flavor. Flock 3 was poorest in juiciness, possible because they were also lowest in marbling.

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