EFFECTS OF ADDITIONAL FEEDING REGIMEN FOR THE OFF-THE-PASTURE LAMBS ON CARCASS TRAITS AND MEAT QUALITY

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Summary

Two hundred eighty weaned Targhee lambs were grazed on annual grass-subclover pastures for 84 d under continuous and rotational defoliation grazing system. At the end of the grazing season, twenty lambs weighing 44 kg were slaughtered directly off the pasture, whereas two groups of 20 lambs each were fed either a alfalfa pellet or a 50% alfalfa/50 concentrate pellet for additional 6 wk until they reached an average live weight of 50 kg. Carcass traits and loin chop palatability were compared. Lambs slaughtered directly off the pasture were lighter than desirable market weight and some lambs had less than adequate fat cover and approximately half of them were graded U.S. Good in quality. Overall conformation and leg muscling was inferior and loin chops were less tender, less juicy and less flavorful. The lambs on alfalfa pellets for 6 wk appeared to be ideal in terms of carcass quality (all Choice except one), fat cover and yield grade. They had better taste panel scores in all palatability traits than off-the-pasture lambs, and most loin chops were acceptable. The lambs on a 50% concentrate diet for 6 wk had a higher conformation score and a greater muscling in the legs. Loin chops had more marbling and better palatability than other groups. However, some lambs had an excessive fat cover and lower yield of retail cuts. It was concluded that additional feeding for 6 wk on alfalfa pellets until the live weight reached 50 kg (for Targhee lambs) was the best way of finishing lambs at the end of grazing season in the California rangeland.

(Key Words : Lambs, Feeding Regimen, Carcass Traits, Palatability)

Introduction

Western agriculture is in transition. Modern agriculturists must focus not only on the productivity of their systems but also their ecological health and long term viability. In the livestock industry, debt and production costs are high, consumer demand is weak, and foreign producers are increasingly competitive. To address such problems, a sustainable agriculture research project was conducted to study an alternative grazing system that coupled sub-clover planting into grass stands with precisely controlled grazing. The lambs grazed on annual grass-subclover pastures were either slaughtered directly off the pasture or placed on two different additional feeding regimens to a heavier weight before slaughter.

A number of studies have consistently shown that the heavier slaughter weight lambs and lambs fed a high concentrate diet had a higher dressing percent, higher percent fat trim, higher quality grades and a lower percent retail yield (Kemp et al., 1970; Thomas et al., 1976; Ely et al., 1979; Crouse et al., 1981; Kirton et al., 1981; Solomon et al., 1986). On the other hand, the effects of slaughter weight and plane of nutrition on the palatability characteristics of meat have been controversial. Jacobs et al. (1972) and Kemp et al. (1972, 1976) reported that lighter lambs were less tender than heavier lambs of the same age with minor differences in flavor and juiciness, whereas Lloyd et al. (1981) reported a greater toughness for the heavy weight lambs. Other investigators (Solomon et al., 1980; Kemp et al., 1981) found no differences in shear value and palatability scores between weight groups. On the effects of diet on palatability traits, Kemp et al. (1981) reported that lambs in drylot groups tended to have more tender meat than those in pasture groups. Crouse et al. (1978) and Kirton et al. (1981) reported a greater toughness for the low energy diet group, whereas Solomon et al. (1986) observed a higher shear value for young ram lambs fed a high concentrate diet.

The objective of the present study was to determine if

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the pasture-finished lambs of lighter weight were comparable in meat palatability to heavier lambs that were additionally fed either alfalfa pellets or 50% alfalfa/50% concentrate pellets.

Materials and Methods

Two hundred eighty predominantly Targhee lambs born in November and December of 1988 at Hopland Field Station, California were used for a comparison study of grazing systems. After lambing, ewes and lambs were grazed on natural rangeland until February 28, 1989. Weaned lambs weighing approximately 24 kg were grazed on annual grass-subclover pastures under continuous and rotational defoliation management. Pastures were grazed for 84 d from February 28 to May 23.

At the end of the grazing season, twenty lambs averaging shorn weight of 44 kg were slaughtered directly off the pasture (group 1). Forty additional lambs weighing 34 to 42 kg were brought to the university feedlot and assigned to two groups, alfalfa pellet group (group 2) and 50% alfalfa/50% concentrate pellet group (group 3). They were fed the respective diet for 6 wk until they reached an average live weight of 50 kg.

The animals were slaughtered at the university abattoir according to the standard commercial procedure. Carcass traits including hot carcass weight, dressing percent, backfat thickness, ribeye area, percent kidney and pelvic fat (KP fat), leg conformation, quality and yield grades were determined. Leg conformation (Prime, Choice, Good, Utility) is the visual assessment of the degree of muscling in the leg. Since lamb carcasses are not ribbed in the commercial practice, leg conformation is used as the assessment of carcass muscling. Quality grade is an estimation of palatability-indicating characteristics (tenderness, juiciness, flavor), while yield grade is an estimation of salable retail cuts. USDA quality grade of lamb carcass (Prime, Choice, Good, Utility) is based upon a composite evaluation of conformation, maturity and quality of the lean fresh. USDA yield grade of lamb carcass (YG 1, 2, 3, 4 and 5) is based on backfat thickness, and yield grade 1 represents the highest yield of retail cuts while yield grade 5 designates the lowest yield of retail cuts.

After 6 d holding in a cooler of 2℃ the carcasses were fabricated into wholesale and retail cuts. Six loin chops from each carcass were vacuum packaged, blast frozen and stored at −20℃ for subsequent palatability evaluation. Loin chops were defrosted in a 4℃ cooler, broiled to an internal temperature of 70℃, and core samples of 2 cm diameter were taken from three chops for Warner-Bratzler (WB) shear press. Longissimus muscles from the remaining three cooked chops were cut and served to taste panel of seven for tenderness, juiciness, flavor and overall palatability evaluation according to the procedure of AMSA (1978).

Approximately 40 g of longissimus muscle was removed from two loin chops of each carcass, pulverized in liquid nitrogen and proximate chemical composition was determined according to AOAC method (1975). Legs with the sirloin area were weighed and dissected into subcutaneous fat, intermuscular fat, muscle, bone and tendon. The separated tissues were weighed and percent composition was calculated.

Data were analyzed by analysis of variance using the GLM procedures of SAS (1982). Means were separated using Fisher's LSD when the respective F-tests were significant.

Results and Discussion

As summarized in table 1, there was a 5 kg difference ($p < 0.05$) in final live weight between group 1 and two additionally fed groups. Though live weights were about equal, group 3 animals fed a 50% concentrate diet had a higher ($p < 0.05$) hot carcass weight and dressing % than group 2. Significant ($p < 0.05$) differences were observed between groups 1 and 2 in backfat thickness, ribeye area, leg conformation and quality and yield grades. Some lambs in group 1 had less than adequate fat cover (< 2.5 mm backfat) and approximately 50% of them graded Good in quality. Some loin chops were too small and soft, which was not attractive. About one-half of group 1 lambs had a less than desirable leg conformation score, indicating inadequate muscling in the leg. The data strongly suggested that the pasture-finished Targhee lambs weighing 44 kg attained a less than desirable muscle and fat tissue development, and an additional gain of 5 kg live weight on alfalfa pellets certainly improved the carcass traits, producing a much desirable carcass for today's market. Group 3 animals had a larger ($p < 0.05$) ribeye area and a slightly higher quality grade than group 2. However, a greater deposition of KP fat and a higher yield grade (or lower % salable retail cuts) and excessive fat cover (over 7.5 mm) in some animals did not appear to justify the slight improvement of quality grades. The lambs on alfalfa pellets for 6 wk (group 2) appeared to be ideal in terms of carcass quality (all Choice except one), fat cover and yield grade.

In leg composition (table 2), group 1 lambs showed a significantly ($p < 0.05$) lower leg weight than groups 2

TABLE 1. EFFECTS OF FEEDING REGIMEN ON CARCASS TRAITS[a]

Item	Group 1	Group 2	Group 3	SE
No. of lambs	20	20	20	
Initial live wt (kg)	44.0[e]	39.6[f]	37.9[f]	0.26
Final live wt (kg)	44.0[e]	49.0[f]	48.2[f]	0.33
Ave daily gain (kg/d)		0.22	0.24	0.01
Hot carcass wt (kg)	19.9[e]	22.9[f]	24.9[g]	0.17
Dressing (%)	45.2[e]	46.7[e]	51.7[f]	0.23
Backfat thickness (mm)	2.5[e]	4.0[f]	5.5[g]	0.17
Ribeye area (cm^2)	10.6[e]	12.3[f]	13.7[g]	0.17
% KP[b]	1.9[e]	2.3[e]	3.0[f]	0.10
Leg conformation[c]	10.3[e]	11.5[f]	11.8[f]	0.12
Quality grade[c]	9.4[e]	10.6[f]	11.0[f]	0.11
Yield grade[d]	2.3[e]	2.8[f]	3.3[g]	0.06

[a] Group 1: Off the pasture.
Group 2: Additional feeding on alfalfa pellet for 6 wk.
Group 3: Additional feeding on 50% alfalfa/50% concentrate pellet for 6 wk.
[b] Kidney and pelvic fat expressed as % of carcass wt.
[c] 9 = Good$^+$, 10 = Choice$^-$, 11 = Choice$^\circ$, 12 = Choice$^+$
[d] YG 1 represents the highest yield of retail cuts and YG5 designates the lowest yield.
[efg] Means with different superscripts in the same row differ significantly, $p < 0.05$.

TABLE 2. EFFECTS OF FEEDING REGIMEN ON LEG COMPOSITION

Item	Group 1	Group 2	Group 3	SE
Leg wt (g)	2,771[a]	3,147[b]	3,174[b]	52
Subcutaneous fat (%)	5.6[a]	7.1[b]	8.4[b]	0.30
Seam fat (%)	3.2	3.6	3.9	0.13
Total fat (%)	8.8[a]	10.7[b]	12.3[b]	0.46
Bone (%)	19.9[a]	18.8[b]	18.1[b]	0.23
Muscle (%)	71.4[a]	70.5[ab]	69.5[b]	0.34

[ab] Means with different superscripts in the same row differ significantly, $p < 0.05$.

and 3 with no differences between the latter two groups. Group 3 had the higher proportion of subcutaneous and seam fat and the lowest bone and muscle %, followed by groups 2 and 1. Though the legs in group 1 were the leanest, the total amount of muscle per leg was 240 g less than that of the other two groups. Between groups 2 and 3, the latter had approximately 50 g more separable total fat per leg with little difference in total muscle weight. Consequently, group 2 yielded the most amount of muscle weight per leg without depositing an excessive amount of fat.

Chemical composition of loin eye muscle (table 3) illustrated that additionally fed animals to a live weight of 50 kg deposited not only more intramuscular fat but also more protein than lighter lambs off the pasture. Feeding a concentrate diet further accelerated the deposition of marbling fat. Although the average % fat in group 1 is 3.3 %, approximately 45% of group 1 animals had less than 3 % chemically determined fat in the loin eye muscle. Although the data for minimum chemical fatness are not as well documented for pork and lamb as they are for beef, Savell and Cross (1988) recommended a minimum level of 3% chemical fat for those cuts from the loin and rack of lamb. According to this recommendation, loin eye muscles from approximately one half of group 1 animals contained less than the minimum level of 3% chemical fat which is desirable for acceptable palatability. All loin eye muscles from groups 2 and 3 had more than 3% fat.

TABLE 3. EFFECTS OF FEEDING REGIMEN ON CHEMICAL COMPOSITION OF LOINEYE MUSCLE

Item	Group 1	Group 2	Group 3	SE
Water (%)	75.4[a]	74.8[b]	74.1[c]	0.10
Fat (%)	3.3[a]	3.6[ab]	4.1[b]	0.11
Protein (%)	20.3[a]	20.6[ab]	20.8[b]	0.06

[abc] Means with different superscripts in the same row differ significantly, $p < 0.05$.

Palatability data for loin chops are summarized in table 4. Loin chops from group 1 were less tender, less juicy and less flavorful; however, two-thirds of the loin chops were rated acceptable in palatability. Group 2 animals showed intermediate taste panel scores in tenderness, juiciness, flavor and overall palatability, and most of them were quite acceptable. Although group 3 lambs showed a lower shear value and higher taste panel scores in all palatability traits compared to group 2 lambs, no statistical difference was observed between the two groups.

It appears that we have to feed lambs to a certain critical body weight and backfat thickness to ensure an acceptable palatability. Based on existing evidence, Tatum (1981) concluded with relative certainty that at least a part of the variation in meat tenderness, associated with differences in preslaughter feeding, can be attributed to the effect of feeding regimens on carcass weight and/or

fatness, and the subsequent effects of these factors on carcass temperature during the first few hours postmortem. For beef carcass subcutaneous fat thickness of 7.6 to 12.7 mm (Bowling et al., 1977; Bowling et al., 1978; Dolezal, 1980; Merkel and Pearson, 1975) and carcass weights in excess of 227 kg (Schupp et al., 1979) appeared to provide maximal protection against rapid postmortem chilling and cold-induced toughness. Other studies with lambs (Kemp et al., 1981) and beef cattle (Bowling et al., 1977; Lee and Ashmore, 1985) supported that feedlot-fed animals tend to have greater tenderness and palatability than grass-fed animals.

TABLE 4. EFFECTS OF FEEDING REGIMEN ON PALATABILITY OF LOIN CHOPS

Item	Group 1	Group 2	Group 3	SE
W-B shear (kg[a])	5.7[c]	5.6[cd]	5.0[d]	0.14
Taste panel score[b]				
Tenderness	5.0[c]	5.5[cd]	5.8[d]	0.15
Juiciness	5.0[c]	5.3[cd]	5.5[d]	0.08
Flavor	4.9[c]	5.3[c]	5.6[d]	0.08
Overall palatability	5.0[c]	5.4[cd]	5.8[d]	0.10

[a] Warner-Bratzler shear force, kg/2 cm core.

[b] 1-8 hedonic scale: 1-extremely tough, extremely dry and extremely bland; 8-extremely tender, extremely juicy and extremely intense.

[cde] Means with different superscripts in the same row differ significantly, $p < 0.05$.

In this study, the critical level of some carcass traits for acceptable palatability was estimated to be 20 kg carcass weight, 2.4 mm backfat thickness and 3% marbling fat in the loin muscles. Approximately one-half of group 1 lambs did not satisfy these critical levels of carcass traits for acceptable palatability. Although group 3 lambs had superior palatability and satisfied the critical levels of important carcass traits, some lambs had an excessive fat cover of over 7.5 mm and a lower yield of salable retail cuts, which did not appear to justify the slight improvement of meat quality and palatability over group 2. Therefore, it was concluded that additional feeding for 6 wk on alfalfa pellets in drylot or, alternatively, additional grazing on irrigated pastures until the live weight reached 50 kg for Targhee lambs (probably other critical live weights for other breeds) would be the recommended way of finishing lambs at the end of the grazing season in California rangeland.

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