A GUIDE FOR SHEEP AND FARM LIFE

# THE SHEPHERD

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*Happy New Year*

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# PROTEIN SUPPLEMENTATION IN DIETS OF PROLIFIC LAMBS

## 1. EFFECT OF DIET

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Little is known on the most effective way of feeding the prolific breeds and their crosses. Sheep breeders raising Finnsheep and its crosses and to lesser extent Romanov sheep and its crosses are all well familiar with the great amount of fat deposition in the body cavity around the kidneys and pelvic areas. Although this excessive deposition of body cavity fat is believed to be genetic in origin, it is possible that feeding diets rich in protein may favor more rapid development of lean tissues and lower fat deposition. Research conducted in England showed that lambs given fish meal had greater gain than non-supplemented lambs. In other evaluations of protein supplements, animals were fed soybean and fish meal, or blood and soybean meal. However, most of these studies did not investigate the nature of that gain made, and since none of these studies involved lambs of prolific breeds a study was designed at La Pocatiere Experimental Farm in Quebec to provide information on the effect of feeding three protein supplements and compare the performance to control lambs not receiving any supplements. In this first part we shall examine the effect of diet, in the second part we shall compare the different breed groups fed these diets.

The 130 lambs used in this study represented two prolific-types, Romanov (R) and Finnsheep (F) and three meat-types; DLS, Coopworth (C) and Suffolk (S). In addition, six prolific crosses were available, first crosses resulting from mating R, F and Booroola Merino (B) rams to DLS ewes and backcrosses to DLS resulting from mating rams from these first crosses to DLS ewes. The lambs were weaned at 50 d. of age and, until the start of the study were fed grass silage free choice supplemented with up to 200 g (.44 lb) per head daily of a grain mixture of different cereals. The lambs were fed from an initial weight of about 23 kg (51 lb) to a slaughter weight of about 43 kg (95 lb) live weight.

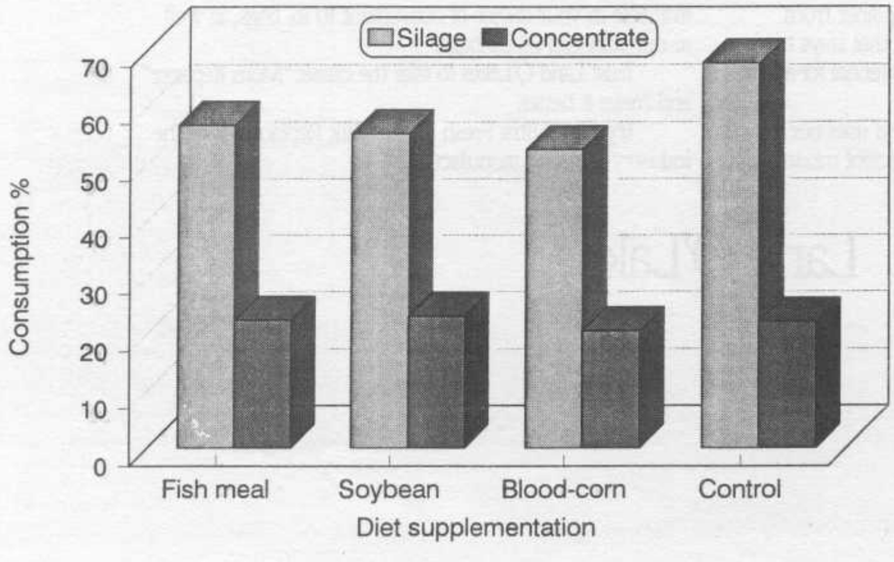
The feeding study started on May 30, 1988. The lambs were distributed among 12 pens to form groups of equal initial weights as much as possible. With a few exceptions, each pen contained 11 lambs, one of each of the 11 genetic groups. The animals were fed a basal ration composed of 75% grass silage and 25% barley-corn concentrate, presented separately. This basal diet was supplemented with one of the following proteins (the figures given in parentheses are the percentages of these nutrients added to the basal diet), fish meal (5.1%), soybean meal (6.9%), or a mixture of corn gluten (1.9%) and blood meal (2.5%). A fourth diet with no protein supplement served as a control. The amount of total digestible nutrients (TDN) of the four diets was essentially the same (between 65.0% for control and 66.5% for soybean meal supplemented diet). The three supplemented diets had a 2.6% more crude protein than the control diet (16% vs 13.4%).

Data were collected on body weight and on daily feed consumption for 96 days from the beginning of the feeding test. Lambs were slaughtered at a local abattoir when they attained about 43 kg (95 lb) live weight. The chilled carcasses were weighed and dressing percentage calculated. The carcasses were then divided into three wholesale cuts; shoulders, loin-racks, and legs; each cut was expressed as a percentage of the chilled carcass weight. Kidney and pelvic fat was removed from the body cavity and weighed. The 12th rib from the right side was separated from the rest of loin-rack area and used for carcass evaluation. For sensory quality, a sample comprising the 9th to 13th ribs from the left side was sent to Food Research Centre in Ottawa for cooking and taste panel evaluation.

Carcass measurements taken on the 12th rib included three color readings of loin eye muscle, "L", measuring the colour between black (zero) and white (100), "a", between red (+) and green (-) and "b", between yellow (+) and blue (-). Backfat thickness over loin eye muscle and area of that muscle measured from a tracing. The 12th rib was trimmed, weighed and dissected into lean, fat and bone, and the percentage of each was calculated.

For meat quality evaluation of the four diets, the roasts from lambs were cooked and each of seven experienced panelist received two slices of each sample from four animals, each was raised on a different diet. Assessors evaluated the perceived intensity of lamb flavor, tenderness and juiciness using a 15 cm (6 in) unstructured line

Silage and Concentrates Consumed by Lambs on Four Diets



scale. From left to right the descriptive anchor points were as follows: tenderness, very tough to very tender; juiciness, very dry to very juicy; and lamb flavor, slight to intense. The presence or absence of off-flavor was also evaluated as "present" or "absent".

The total gain made by the lambs on the different diets was similar since initial weights were balanced among treatments and slaughter weight was fixed at around 43 kg live weight. However, the lambs on the control and soybean meal diets needed 12 days longer time on feed than lambs on the other two diets, a difference that was statistically significant. Average daily gain of lambs fed fish meal (226 g, .50 lb) and corn gluten-blood meal (217 g, .48 lb) were statistically higher than lambs fed the soybean meal (189 g, .42 lb) and those fed the control diet (186 g, .41 lb). Feed conversion ratio was lowest in lambs fed fish meal (4.99) and corn gluten-blood meal (5.11) followed by those fed soybean meal (5.48) which in turn were superior to those fed the control diet (5.76). As can be noticed from figure 1, lambs fed diets supplemented with protein consumed between 16 and 22% less silage than those non-supplemented. The consumption of concentrate mixture was similar in four groups.

Using the prevailing prices at the time this experiment was conducted, (C$ 80 for a ton of silage, 194.3 for fish meal, 165.4 for soybean and 181.6 for corn gluten-blood supplemented diets and 139.2 for the control diet), the cost of feed per kg of live body weight, dressed weight or per kg of lean meat produced (using the dissection of the 12th rib as an indicator of carcass lean content) was calculated and presented in table 1. The calculations indicated similar cost for the control and the supplemented groups. However, extending the calculations further to take into account the rate of turnover of capital (multiplying by number of animal days and dividing by 100), lambs on the control diet which took on average 12 days more to reach slaughter weight tended to cost more to produce one kg of lean than those on corn gluten-blood meal and fish meal diets, the differences of 65 and 53 cents per kg were, however, not significant statistically.

The effect of diet on carcass traits and composition was slight (Table 2). The analysis of the 12th rib showed that lambs on the control diet had more fat and less lean content than lambs on the

**Table 1. Means for cost of producing lambs fed different protein diets.**

| | Feeding treatment | | | |
|---|---|---|---|---|
| | Fish meal | Soybean meal | Blood corn-gluten meal | Control |
| Number of animal days | 70.1[a] | 76.0[ab] | 66.1[a] | 83.8[b] |
| Daily gain on test in grams | 226[a] | 189[b] | 217[a] | 186[b] |
| Cost per lamb[1] | 8.87 | 8.23 | 7.90 | 8.47 |
| Cost per kg gain[1] | .56 | .58 | .55 | .55 |
| Cost per kg dressed[1] | 1.37 | 1.39 | 1.36 | 1.33 |
| Cost per kg lean[1] | 3.29 | 3.30 | 3.29 | 3.37 |
| Cost, adjusted for days[1] | 2.31 | 2.51 | 2.18 | 2.83 |

[a-b] Means followed by different letters are significantly different.
[1] All costs are in Canadian dollars.

**Table 2. Means for carcass characteristics of lambs fed different protein supplement diets.**

| | Feeding treatment | | | |
|---|---|---|---|---|
| | Fish meal | Soybean meal | Blood corn-gluten meal | Control |
| **Carcass Percentages:** | | | | |
| Dressing out | 41.4 | 42.4 | 40.8 | 42.2 |
| Leg | 33.4 | 33.5 | 33.6 | 32.9 |
| Loin-rack | 28.9 | 29.1 | 28.6 | 29.0 |
| Shoulder | 37.8 | 37.6 | 37.8 | 38.1 |
| Kidney fat | 2.8 | 2.9 | 2.6 | 3.2 |
| **12th rib measurements** | | | | |
| Average fat thickness (mm) | 3.9 | 4.4 | 4.2 | 4.5 |
| Area of loin-eye ($cm^2$) | 12.6 | 12.3 | 11.9 | 11.9 |
| Muscle (%) | 42.0[a] | 41.8[a] | 41.6[a] | 39.9[b] |
| Fat (%) | 36.3[a] | 37.5[a] | 35.8[a] | 39.2[b] |
| Bone (%) | 20.6 | 19.5 | 21.2 | 19.8 |
| Color L[1] | 26.1 | 25.5 | 26.1 | 25.5 |
| Color a[1] | 5.1 | 5.0 | 5.3 | 5.3 |
| Color b[1] | 5.7 | 5.4 | 5.7 | 5.6 |
| Intramuscular fat (%) | 9.6 | 10.1 | 9.6 | 9.6 |

[a-b] Means followed by different letters are significantly different.
[1] See text for explanation.



**Table 3. Meat quality evaluation of lambs fed different supplemented diets.**

| | Feeding treatment | | | |
|---|---|---|---|---|
| | Fish meal | Soybean meal | Corn-blood meal | Control |
| Tenderness[1] | 6.2 | 8.5 | 5.3 | 6.3 |
| Juiciness[1] | 7.6 | 7.6 | 7.6 | 8.7 |
| Flavor[1] | 8.6 | 8.9 | 8.0 | 8.9 |
| Off-flavor % | 8.7 | 2.2 | 4.3 | 4.3 |

[1] On a scale of 1-15.

supplemented diets. No other significant diet effects were observed.

The taste panel did not detect significant differences among meat samples of lambs fed the different supplemented diets (Table 3). Accordingly, these diets may have little effect on meat tenderness, juiciness and flavor, although there are some indications that lambs fed the soybean supplement were slightly more tender and had less off-flavor taste than those fed fish meal and corn gluten-blood meal or no supplement.

There is a common agreement that protein supplementation has a general beneficial effect on growth and carcass traits, manifested in an increase in daily intakes, improved daily gains, carcass weights and carcass characteristics. In many cases, however, these improvements failed to reach significant levels. Many different sources of protein supplementation were compared in numerous studies; these studies as well as ours have shown small differences from the source of supplementary protein. When soybean meal was compared with other sources of protein supplement, lambs fed the soybean meal showed slightly inferior gains and feed conversion efficiency. It seems, however, that protein supplementation may have an effect in reducing fat deposition in the body as evidenced from this and other studies.

It can be concluded from this study that although supplementing the diets of growing lambs with soybean or industry byproducts to increase protein content may seem at first to be an expensive proposal, however, when considering the better feed conversion and the shorter period on feed, protein supplementation may prove to be economically advantageous. Products such as fish meal which were reported to affect flavor of meat in chicken had no such effect on sheep meat, and therefore, can be recommended in lamb diets.

## 2. EFFECT OF BREED

In the first part we examined the effect of supplementing the diet of lambs with different sources of protein. In this part we shall present the performance of the different breeds and crosses involved in this study. Before that we had to examine the interaction between the diet and the genetic group. Significant interaction implies that certain breeds or crosses may perform differently on different diets, in such cases, the results for diet and breed should be presented in detail, i.e., the performance of lambs of all genetic groups on each of the four diets. However, when the interaction is not significant, the results of feeding the four diets can be pooled together and only one estimate for each breed or cross can be presented. Fortunately in this study, all but one interaction were not significant and in the one that was significant, significance was caused by certain animals and when removed the interaction between diet and breed became non-significant.

The present paragraph is to remind you briefly of some of the details given in the first part on the animals and the diets fed. All together, 130 lambs from ten breeds and crosses were involved. These represented two types of sheep, prolific (Romanov and Finnsheep) and meat (Coopworth, Suffolk and DLS). In addition, three first crosses resulted from mating Romanov, Finnsheep and Booroola rams to DLS ewes, referred to here as 1/4-R, 1/2-F and 1/2-B, respectively, and finally three backcrosses resulted from mating 1/2-R, 1/2-F and 1/2-B rams to DLS ewes, referred to as 1/4-R, 1/4-F and 1/4-B, respectively. Lambs of these breeds were fed between 51 and 95 lb live weight, a basic diet of silage and concentrate supplemented with either fish meal, soybean meal, or corn gluten-blood meal. A group was not protein supplemented and served as a control.

The traits studied were growth rate, feed efficiency, carcass measurements and meat quality judged by a taste panel. Average daily gain to slaughter was generally low for the different genetic groups ranging from 141 g (.31 lb) for Romanov lambs to 199 g (.44 lb) for Suffolk lambs. Finnsheep-DLS first cross lambs were the youngest (196 d.) at slaughter whereas Finnsheep lambs were the oldest (264 d.).

Significant differences observed among genetic groups in many of the carcass traits studied were mainly between prolific- and meat-type lambs (Table 1). Finnsheep lambs had higher dressing percentage than meat-type lambs such as Suffolk and Coopworth. The proportions of the three wholesale cuts, shoulder, loin-rack and legs, varied within narrow ranges among the different breeds and crosses. The two prolific breeds, Romanov and Finnsheep, had slightly higher shoulder proportions than meat-type animals (39.3 vs 37.2%), and the crosses were intermediates. As expected, Finnsheep lambs had the highest kidney fat percentage (3.7%) followed by Romanov (3.4%) and Romanov crosses (2.9%). Meat-type breeds and Booroola crosses had the least kidney fat percentage. On the other hand, the meat-type lambs had thicker backfat than the prolific-type lambs. DLS lambs had the largest and Coopworth lambs the smallest area of loin eye (14.0 vs 10.7 $cm^2$, 2.17 vs 1.66 $in^2$). Among the first crosses, the Booroola cross had larger loin eye area than Finnsheep and Romanov crosses. Percent lean, fat and bones in the 12th rib varied slightly between the different breeds and crosses. Romanov lambs had significantly more bone and less fat than Finnsheep while Coopworth lambs had the lowest lean and highest bone percentages among the other meat-type breeds studied. Romanov lambs were among the lowest in intramuscular fat (8.9%), significantly lower than in Finnsheep lambs (11.7%). Some differences in color of the loin eye muscle were significant, mainly between prolific (paler) and meat-types and between prolific and Booroola first cross (paler).

The comparison of the five pure breeds and the three first crosses indicated no significant effects observed for the parameters of cooking rate, weight loss, and drip loss.

The sensory analysis results presented in Table 2 showed significant differences in tenderness among the crosses despite a good deal of variation among roasts for this trait. The 1/2-R and 1/2-F were tougher than the 1/2-B. No significant effect was found for juiciness. Meat of Finnsheep lambs exhibited the most intense flavor (10.5), significantly more than for Romanov lambs or the three meat-type breeds. A significantly higher percentage of lambs with off-flavors was found in prolific vs meat-type breeds (11.8 vs 4.8%).

Considering age at slaughter as an indicator of overall growth rate, 1/2-F and 1/2-R lambs were youngest followed by Suffolk lambs, whereas Finnsheep and 1/2-B lambs ranked last. The two prolific breeds had the highest percentage of kidney fat on all diets, therefore, it does not seem that the protein supplementation applied in this study changed this tendency. In contrast, the three non-prolific breeds had a thicker fat cover on the body.

In conclusion, the different breeds and crosses responded in a similar manner to the feeding treatments. There were many differences among breeds mainly between prolific and non-prolific. The first and backcrosses with the DLS were generally similar in performance.



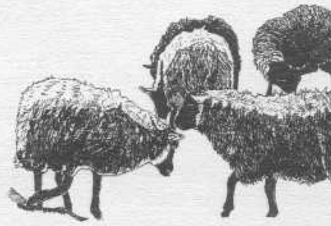




**Table 1. Means for gain and carcass characteristics of lambs of different breeds and crosses.**

| Item | Pure breeds: Meat-type S | C | DLS | Prolific-type R | F | First cross with DLS 1/2-R | 1/2-F | 1/2-B | Backcross with DLS 1/4-R | 1/4-F | 1/4-B |
|---|---|---|---|---|---|---|---|---|---|---|---|
| No. of lambs | 12 | 11 | 11 | 11 | 12 | 13 | 12 | 9 | 12 | 12 | 15 |
| ADG to slaughter, g | 199 | 151 | 171 | 141 | 148 | 194 | 185 | 162 | 175 | 165 | 173 |
| Age at slaughter, d | 204 | 222 | 239 | 222 | 264 | 198 | 196 | 243 | 220 | 231 | 232 |
| **Carcass percentage** | | | | | | | | | | | |
| Dressing | 40.7 | 39.1 | 43.5 | 41.2 | 43.7 | 41.5 | 40.9 | 42.3 | 40.4 | 43.4 | 42.9 |
| Leg | 34.3 | 33.8 | 33.4 | 33.4 | 31.0 | 33.4 | 33.4 | 33.3 | 34.0 | 33.3 | 33.6 |
| Loin-rack | 28.4 | 29.3 | 29.2 | 28.3 | 29.3 | 29.3 | 28.7 | 28.2 | 28.7 | 29.5 | 28.9 |
| Shoulder | 37.3 | 36.9 | 37.4 | 39.0 | 39.6 | 37.4 | 37.9 | 38.6 | 37.3 | 37.3 | 37.5 |
| Kidney fat | 2.74 | 2.56 | 2.61 | 3.37 | 3.71 | 3.00 | 2.86 | 2.80 | 2.87 | 2.77 | 2.38 |
| **12th rib measurements** | | | | | | | | | | | |
| Avg. fat thickness, mm | 4.0 | 4.7 | 4.1 | 3.0 | 3.9 | 4.4 | 4.3 | 5.1 | 4.0 | 4.8 | 4.4 |
| Loin eye area, cm² | 11.8 | 10.7 | 14.0 | 10.8 | 11.4 | 11.9 | 12.5 | 13.7 | 11.8 | 12.7 | 12.7 |
| Muscle, % | 41.1 | 39.1 | 42.4 | 43.8 | 41.1 | 39.8 | 42.7 | 39.9 | 42.7 | 40.8 | 41.0 |
| Fat, % | 35.6 | 37.6 | 37.6 | 31.8 | 38.4 | 39.7 | 36.7 | 41.5 | 35.7 | 38.0 | 36.8 |
| Bone, % | 22.2 | 22.4 | 18.8 | 23.2 | 19.0 | 19.1 | 19.3 | 17.4 | 20.3 | 19.7 | 21.5 |
| Color L | 26.0 | 28.1 | 26.3 | 25.2 | 24.3 | 28.1 | 25.4 | 23.7 | 26.9 | 24.3 | 25.3 |
| Color a | 4.6 | 5.6 | 5.1 | 5.4 | 5.1 | 5.4 | 5.2 | 4.7 | 5.2 | 5.0 | 5.6 |
| Color b | 5.4 | 6.1 | 5.7 | 5.2 | 5.1 | 6.2 | 5.4 | 5.1 | 6.0 | 5.3 | 5.9 |
| Intramuscular fat, % | 9.4 | 9.6 | 10.5 | 8.9 | 11.7 | 10.8 | 8.9 | 9.2 | 9.2 | 8.8 | 10.3 |

OS = Suffolk; C = Coopworth; DLS = a new breed developed in Canada; R = Romanov; F = Finnsheep; B = Booroola Merino.

**Table 2. Meat quality evaluation of roasts from prolific and meat-type breed and crosses.**

| Trait | Pure breeds: Meat-type S | C | DLS | Prolific-type R | F | First crosses 1/2-R | 1/2-F | 1/2-B |
|---|---|---|---|---|---|---|---|---|
| Tenderness[1] | 9.3 | 7.1 | 6.8 | 6.8 | 7.5 | 5.9 | 6.3 | 9.1 |
| Juiciness[1] | 7.7 | 8.4 | 7.8 | 7.7 | 8.7 | 7.6 | 8.4 | 7.7 |
| Flavor[1] | 8.1 | 7.4 | 8.1 | 8.5 | 10.5 | 7.9 | 8.4 | 9.3 |
| Off-flavor, % | 1.7 | 4.8 | 7.8 | 12.1 | 11.5 | 7.3 | 10.0 | 3.5 |

S = Suffolk; C = Coopworth; DLS = a new breed developed in Canada; R = Romanov; F = Finnsheep; B = Booroola Merino.
[1] On a scale of 1-15.