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Abstract
Holstein steer calves (n = 96) were on experiment from 8 to 18 wk of age. Control calves were fed a diet in which all supplemental protein was from soybean meal; in the experimental diet, part of the soybean meal was replaced by fish meal. Both feeds were readily consumed, and consumption did not differ between treatments. Gains of calves fed fish meal were greater (P = .10) during the first 8 wk of the experiment; however, over the entire experiment, the difference was not significant. Overall results suggest that fish meal may improve weight gains and feed efficiency of younger and smaller calves.; Dairy Day, 1992, Kansas State University, Manhattan, KS, 1992;

Keywords
Dairy Day, 1992; Kansas Agricultural Experiment Station contribution; no. 93-131-S; Calves; Grower diets; Fish meal; Protein source

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FISH MEAL AS A PROTEIN SOURCE FOR HOLSTEIN STEER CALVES

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Summary

Holstein steer calves (n = 96) were on experiment from 8 to 18 wk of age. Control calves were fed a diet in which all supplemental protein was from soybean meal; in the experimental diet, part of the soybean meal was replaced by fish meal. Both feeds were readily consumed, and consumption did not differ between treatments. Gains of calves fed fish meal were greater (P = .10) during the first 8 wk of the experiment; however, over the entire experiment, the difference was not significant. Overall results suggest that fish meal may improve weight gains and feed efficiency of younger and smaller calves.

(Key Words: Calves, Grower Diets, Fish Meal, Protein Source.)

Introduction

Approximately one-half of all calves born are bulls and, because of the widespread use of artificial insemination, few of these are needed for breeding purposes and, therefore, are available for production of meat. In recent years, large calf-feeding ranches have been developed that specialize in growing Holstein calves to a weight at which they are shipped to feedlots and finished on full feed. If properly fed and managed, the Holstein steer produces meat that is lean, tender, and flavorful.

The period from weaning to about 3 mo of age is still a high risk time for calves, with respiratory problems being especially serious. There is little information concerning optimum feeding programs for weaned Holstein calves that are kept on full feed. Specifically, the rumen undegradable protein requirement of this age animal is not known. Fish meal is a good source of high quality undegradable protein and may contain other special nutritional properties as well. The objective of this experiment was to evaluate fish meal as a partial replacement of soybean meal as a protein source for Holstein calves from 8 to 18 wk of age.

Procedures

Holstein steer calves (n = 96), 8 wk of age, were divided by body weight into two groups (heavy and light weight). Within each group, calves were assigned to two treatments, fish meal or soybean meal supplements. After assignment and placement in lots, the animals were weighed on 2 consecutive days, and the average of these weights was used as the beginning weight. The calves were weighed at 12 and 16 wk of age and on 3 consecutive days at the end of the experiment at 18 wk of age. Withers height was recorded at the beginning and end of the experiment.

The diets (Table 1) consisted of 1 part pelleted supplement (Table 2) and 3 parts whole shelled corn. Feed was added daily to ensure ad libitum consumption, and orts were

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measured weekly to allow calculation of weekly feed consumption.

Table 1. Analysis of Finished Feeds

| Item          | Fish Meal | Soybean Meal |
|--------------|-----------|--------------|
| Dry Matter, %| 90.2      | 90.2         |
| Crude Protein, % | 16.3   | 17.1         |
| Calcium, %   | .72       | .83          |
| Phosphorus, %| .41       | .42          |

Results and Discussion

All animals in the heavy group fed fish meal completed the experiment. Two calves in the light group on fish meal, five calves in the heavy group on soybean meal, and three calves in the light group on soybean meal were removed because of poor health, primarily respiratory problems.

Feed consumption is shown in Table 3. Both feeds were readily consumed, and consumption did not differ between treatments.

Body weights and gains are shown in Tables 4 and 5, respectively. Gains were greater on fish meal diets during the first 4 wk of the experiment, but the differences were not significant. Variability among animals is high at this age, as is shown by the large standard deviations. Differences between treatments from the fifth through the eighth wk of the experiment, as well as throughout the first 8 wk, were significant (P = .10).

Over the entire experiment, differences between treatments were not significant; weight gains were higher for the heavy group of calves fed diets containing soybean meal and for the light group of calves fed diets containing fish meal. It should be noted that calves removed from an experiment are often the ones that are not doing as well; thus, average gains of remaining calves are increased. The result of this would be that average gains of calves fed soybean meal would be inflated, because more calves were culled from that group.

Feed efficiency, expressed as amount of feed required per pound of gain, is shown in Table 6. Less feed was required when animals were fed fish meal during wk 1 to 4 and 5 to 8. During the last 2 wk of the experiment, the results depended on the group, with the light group benefitting more from the fish meal diet.

Heights at the withers at the beginning and at the end of the experiment and changes in wither height are shown in Table 7. Differences by treatment were not significant.

The results of this experiment suggest that fish meal may improve weight gains and feed efficiency in young calves, with more benefit likely for younger and smaller calves. The number of animals removed from the experiment may have been too small to draw conclusions; however, the possibility that fish meal may have provided some protection should be considered. More information is needed concerning the benefit of fish meal in rations for young dairy calves and for stressed animals.
### Table 2. Composition of Supplement Pellets

| Ingredients                        | Fish Meal | Soybean Meal |
|------------------------------------|-----------|--------------|
| Soybean Meal                       | 64.08     | 87.68        |
| Fish Meal                          | 14.00     |              |
| Wheat Middlings                    | 11.45     |              |
| Limestone, ground                  | 4.15      | 5.20         |
| Alfalfa, dehydrated                | 2.50      | 2.50         |
| Salt, mixing                       | 2.00      | 2.00         |
| Dicalcium phosphate                | 1.30      |              |
| Potassium chloride                 | .90       | .35          |
| Trace mineral supplement           | .38       | .38          |
| Vitamin supplement                 | .25       | .25          |
| Vitamin E supplement               | .25       | .30          |
| Lasalocid                          | .05       | .05          |

Calculated nutrient content and, in parentheses, analyzed content

|                | Fish Meal | Soybean Meal |
|----------------|-----------|--------------|
| Crude protein, % | 39.00 (38.54) | 39.01 (39.05) |
| Undegraded protein, % | 13.84 | 11.75 |
| Metabolizable energy, Mcal/lb | 1.08 | 1.08 |
| Fat, % | 2.18 | .53 |
| Acid Detergent Fiber, % | 8.62 | 8.90 |
| Neutral Detergent Fiber, % | 13.31 | 12.32 |
| Calcium, % | 2.75 (3.16) | 2.74 (2.53) |
| Phosphorus, % | .92 (.98) | .85 (.83) |

### Table 3. Average Daily Feed Consumption per Animal, lb

| Diet       | Group | Weeks of experiment |
|------------|-------|---------------------|
|            |       | 1  | 2  | 3  | 4  | 5  | 6  |
| Fish meal  | Heavy | 5.1 | 5.5 | 6.4 | 6.6 | 7.3 | 8.8 |
|            | Light | 4.4 | 5.3 | 5.7 | 5.9 | 6.8 | 7.9 |
| Soybean meal | Heavy | 4.0 | 4.6 | 5.7 | 6.2 | 6.6 | 8.1 |
|            | Light | 4.2 | 5.1 | 5.7 | 6.4 | 6.4 | 7.7 |

| Diet       | Group | Weeks of experiment |
|------------|-------|---------------------|
|            |       | 7  | 8  | 9  | 10 | 1-10 |
| Fish meal  | Heavy | 9.7 | 10.8 | 10.8 | 12.3 | 8.4 |
|            | Light | 9.5 | 10.1 | 9.9 | 11.2 | 7.7 |
| Soybean meal | Heavy | 9.9 | 10.6 | 11.0 | 13.0 | 7.9 |
|            | Light | 9.5 | 9.5  | 10.8 | 11.9 | 7.7 |
**Table 4. Body Weights (lb) of Animals, (± Standard Deviation)**

| Diet          | Group | 0     | 4     | 8     | 10    |
|---------------|-------|-------|-------|-------|-------|
| Fish meal     | Heavy | 159 ± 10 | 211 ± 26 | 305 ± 42 | 341 ± 49 |
|               | Light | 140 ± 9  | 193 ± 29 | 285 ± 40 | 323 ± 45 |
| Soybean meal  | Heavy | 156 ± 11 | 200 ± 39 | 296 ± 50 | 345 ± 47 |
|               | Light | 140 ± 10 | 188 ± 35 | 265 ± 50 | 310 ± 50 |

**Table 5. Gain (lb) in Body Weight of Animals (± Standard Deviation)**

| Diet          | Group | 1-4   | 5-8   | 1-8   | 9-10  | 1-10  |
|---------------|-------|-------|-------|-------|-------|-------|
| Fish meal     | Heavy | 52 ± 23 | 94 ± 20 | 146   | 36 ± 11 | 182 ± 45 |
|               | Light | 53 ± 24 | 89 ± 17 | 142   | 38 ± 8  | 183 ± 41 |
| Soybean meal  | Heavy | 43 ± 35 | 87 ± 25 | 130   | 39 ± 12 | 186 ± 45 |
|               | Light | 47 ± 34 | 74 ± 23 | 121   | 39 ± 14 | 169 ± 48 |
| *P*           |       | .53    | .09   | .096  | .71   | .57   |

*P = Probability of difference between treatments, within initial weight groups.

**Table 6. Feed Efficiency (Pounds Feed/Pounds Gain)**

| Diet          | Group | 1-4 | 5-8 | 9-10 |
|---------------|-------|-----|-----|------|
| Fish meal     | Heavy | 3.17| 2.73| 4.45 |
|               | Light | 2.81| 2.70| 3.86 |
| Soybean meal  | Heavy | 3.30| 2.84| 4.29 |
|               | Light | 3.16| 3.13| 4.07 |

**Table 7. Withers Height and Increases in Withers Height, Inches**

| Diet          | Group | Weeks of Experiment                                      |
|---------------|-------|----------------------------------------------------------|
| Fish meal     | 1     | 32.0 ± 1.5                                               |
|               | 2     | 30.9 ± 1.5                                               |
| Soybean meal  | 1     | 32.0 ± 1.5                                               |
|               | 2     | 31.1 ± 1.5                                               |