STUDIES ON DAIRY BEEF PRODUCTION

K. P. Miller
R. D. Goodrich
J. C. Meiske
C. W. Young

Station Bulletin AD-SB-2896
Agricultural Experiment Station
University of Minnesota 1986

Acknowledgements

Thanks is expressed to the following for products or services involved in conducting these trials:

Elanco Products Company, Indianapolis, Indiana

Forster's Packing Company, Minneapolis, Minnesota

George A. Hormel Company, Austin, Minnesota

Hubbard Milling Company, Mankato, Minnesota

International Minerals and Chemical Corporation, Libertyville, Illinois

Chas. Pfizer and Company, Terre Haute, Indiana

A. O. Smith, Harvestore Products, Inc., Arlington Heights, Illinois

Syntex Laboratories, Inc., Denver, Colorado

Wilson and Company, Albert Lea, Minnesota

Elmer Minske, Gary Dobberstein and David Ziegler who fed and cared for the animals and collected data.

C. C. Kimura, Tom Peters and J. E. Garrett for assistance in statistical analysis.

STUDIES ON DAIRY BEEF PRODUCTION

K.P. Miller, Southern Experiment Station
R.D. Goodrich, Department of Animal Science
J.C. Meiske, Department of Animal Science
C.W. Young, Department of Animal Science

AD-SB-2896

Agricultural Experiment Station
University of Minnesota
St. Paul, MN 55108

1986

TABLE OF CONTENTS

TABLES

Page

INTRODUCTION

More than four million bull calves from the larger dairy breeds are born each year in the U.S. Only a few are needed for breeding purposes and the rest are potential meat producers. Bull calves from the larger dairy breeds are readily available in the leading dairy states, and grade changes in 1976 have stimulated further interest in dairy beef.

Early reports by Bohstedt (1922) and Fuller (1930) showed that dairy steers grew at a rapid rate and produced lean carcasses, but graded low because they lacked desirable conformation and fat cover compared to typical beef steers. Branaman and Brown (1937) and Matsushima et al. (1949) reported similar differences. Kidwell and McCormick (1956) compared Hereford and Holstein steers and concluded that dairy steers of large mature size gained more rapidly, required less feed per unit gain and produced carcasses with higher percentages of bone and lean but less fat than beef steers.

Studies by Hibbs et al. (1959), Branaman et al. (1962), Hanke et al. (1964), Cole et al. (1964 a,b) and Bond et al. (1972) also showed that dairy steers from the large breeds performed as well as beef steers in the feedlot, had lower dressing percentages and produced carcasses with lower conformation scores, less marbling and fat cover, but cut a higher percentage of lean with equal eating qualities. Hooven et al., (1972) reported that Holstein steers gained faster and more efficiently than Angus, Milking Shorthorn and Jersey steers.

Few trials have been reported in which rations or feeding programs for dairy steers have been evaluated. Hibbs et al. (1959) found no difference in daily gain by steers fed rations of 1.1:1 or 2.2:1 concentrate to forage ratios. Lester et al. (1968) compared growing rations with 0, 20 or 40% hay and Kesler et al. (1975) fed two levels of forage to growing-finishing steers. In both reports, daily gain decreased with increasing forage levels. The alfalfa hay used in the latter report was ground and the authors concluded that complete ground diets should not be fed over extended periods because of severe bloat problems.

Limited information is available on the most desirable weight to market dairy steers. Small differences in rate or efficiency of gain were found by Kesler et al. (1975) when steers were fed to 1,125 or 1,222 lb final weight. This probably occurred because a poor feed efficiency during the latter period would have little effect on feed efficiency for the total feeding period. The larger steers produced carcasses with higher marbling scores, higher grades and larger rib eyes.

Most dairy calf nutrition research has been conducted on replacement females and beef calf nutrition trials start at a later age because the young beef calf nurses the cow for several months. Consequently, few studies have been conducted on young dairy steer calves that will be slaughtered a year later.

Martin et al. (1962) reported little effect of early feeding regimens on later rate of gain; however, Bond et al. (1972) found that calves on a low plane of nutrition for 180 days gained faster after 180 days than those fed a higher energy ration the first 180 days. This compensatory gain effect was not observed by Kesler et al. (1975). Three levels of hay were fed to 12 weeks of age by Hibbs et al. (1956); they found that rate and efficiency of gain and percentage protein digested increased as proportion of hay in the diet was reduced. Jahn et al. (1970) fed five levels of straw (5 to 60%) to calves from 8 to 20 weeks of age. They found that performance was not reduced with increased straw until the ration contained 23% or more acid detergent fiber. Decreased daily gains and feed efficiencies were observed by Lester et al. (1968) as percentage hay in the ration increased from 0 to 40%.

The National Research Council (NRC) (1984) recommendation for 300 lb large frame steer calves gaining 2.5 lb/day is 16.3% crude protein and NRC (1978) recommends 16% crude protein, in dairy calf starters. Brown et al. (1958) found no improvement in rate or efficiency of gain with more than 12.2% crude protein in dairy calf starter. Several other investigators reported no advantage in daily gain by calves fed 16% protein starter compared to lower levels (Hibbs and Conrad, 1958; Gardner, 1968; Daniels and Flynn, 1971; Morrell and Melton, 1973). Jahn and Chandler (1976) reported increased protein requirements as ration fiber increased. Reduced feed per unit gain was observed by several of the above investigators as protein level in the diet increased. Jacobson (1969) concluded that a 110 lb calf required .37 lb digestible protein daily.

Calf starters fed with milk feeding programs can contain 1 to 1.5% urea according to NRC (1976). Brown et al. (1956) reported comparable gains when young calves were fed low protein rations supplemented with either urea or linseed meal. A later report by Brown et al. (1960) showed that 2.2% urea added to a 7.1% crude protein starter resulted in faster gains than starters with 1.1 or 3.3% urea when fed to calves starting at 5 weeks of age. Wallenius and Murdock (1977) suggested that calves may use urea before 4 weeks of age and found that 4 to 8 week old calves did utilize urea. However, urea additions to a low protein calf starter did not improve rate of gain in a study by Stabo et al. (1967).

Several reports on relationships between dairy production and beef traits have been published. These reports usually show small, positive, but nonsignificant relationships (Bara, 1981; Calo et al., 1973b; Falkenburg et al., 1968; Nichols and White, 1964; Sims et al., 1972). Mason (1964) reported nonsignificant relationships between milk production and some beef traits in steer offspring. At low production levels, Suess et al. (1968) observed negative relationships between breeding values for milk and some carcass traits. Touchberry (1951) concluded that size or other physical traits were not genetically correlated with production, and Tyler (1970) concluded that there were no strong genetic relationships between milk production of cows and growth, feed efficiency or carcass traits of their sons. Calo et al. (1973a) and Nichols and White (1964) also reviewed the limited number of heritability estimates for beef traits that have been calculated from dairy steer data.

MATERIALS AND METHODS

Since these trials were initiated in 1962, several common procedures have been followed. Calves were housed in either individual huts or in a controlled environment area until 2 to 3 months of age. From 2 to 3 months of age, all calves were housed until marketed in groups of five to seven steers in a confined, bedded pole building. In this building the animals were self-fed or full-fed until sold. Water was available from automatic waterers. Small calves were from the Waseca Experiment Station dairy herd or were purchased from three University and five Minnesota Department of Welfare herds.

Initial and final weights were shrunk weights--that is, feed and water were withheld for 16 to 18 hours prior to weighing. Final weights used for rate of gain and feed efficiency calculations were adjusted using standard dressing percentage values calculated from live and carcass weights of animals within a trial. This removes differences in final weight due to fill. Animals were marketed when individuals or pens averaged approximately 1,050 lb.

Carcass data were collected in commercial plants. In this report, marbling scores are: traces, 3; slight, 4; small, 5; etc. Conformation scores and quality grades are: low good, 9; average good, 10; high good, 11; etc. All carcass grades are expressed according to USDA grading standards in use during 1983. Kidney, heart and pelvic fat (KHP) is expressed as a percent of carcass weight.

Growth promotants were used throughout these trials, and monensin was fed after 1972 to growing-finishing steers.

CALF TRIALS

Common Procedures

Soon after birth, calves were given an oral vaccine (rota-corona) and fed colostrum. Purchased calves were grouped by farm of origin by partitioning them in a clean truck. On arrival at the station, the calves were placed in individual outside huts or in individual calf pens. By 10 to 14 days of age, all healthy calves were maintained in individual calf pens. Calf starter was offered at 5 to 7 days of age and calves were weaned from milk at 28 days. Calves were castrated and dehorned at approximately 6 weeks of age.

Starter rations were fed from 5 to 7 days of age to 300 to 400 lb, growing rations were fed from 300 to 400 lb to about 700 lb and finishing rations were fed from about 700 lb to market weight. To more accurately determine effects of feeding programs, all animals were fed to market weight.

TRIAL 1. EFFECTS OF HAY LEVEL IN STARTER RATIONS AND AMOUNT OF CORN SILAGE IN GROWING AND FINISHING RATIONS

Procedure

Complete starter rations containing 0, 15 or 30% ground alfalfa hay were fed until the average pen weight was 300 lb. Compositions of the starters are shown in Table 1. From 300 to 600 lb, calves were fed either an all-concentrate ration of rolled shelled corn and 1 lb of urea-containing supplement per day, or a ration of six parts corn silage to one part concentrate (rolled shelled corn and 1 lb urea-containing supplement). Supplements are described in Table 2. Cattle were finished on either an all-concentrate ration or one of equal parts corn silage and concentrate. All portions were on an as-fed basis, and the corn silage averaged approximately 35% dry matter. Feed data are expressed on a dry matter (DM) basis.

Results and Discussion

Calves fed a 15% hay ration during the period from 95 lb to 300 lb gained slightly faster during that period (1.62 lb/day) than calves fed 30% hay (1.56 lb/day) or all concentrate (1.49 lb/day) rations (Table 3). However, after 300 lb, calves started on the 30% hay ration gained faster during the period 300 to 600 lb ($P<.01$; Table 4) and from 600 lb to market ($P<.05$; Table 5) than calves fed the other two rations.

Steers fed the all-concentrate ration from 300 to 600 lb (Table 4) gained faster ($P<.01$) than those fed the high silage ration (2.42 versus 2.12 lb/day). There was no difference in rate of gain during the finishing period (2.73 versus 2.71 lb/day) by steers fed an all-concentrate or a ration of equal parts corn silage and concentrate (Table 5).

There were significant ($P<.05$) differences in rates of gain from 95 lb to market weight. For the entire feeding period (Tables 6, 7), calves initially fed the 30% hay ration gained 2.26 lb/day compared to 2.17 and 2.12 lb/day by calves fed 15% hay and all-concentrate starters, respectively. Steers fed the higher concentrate rations were the most efficient in use of dry matter (Tables 3, 4, 5). Those fed the 30% hay ration to 300 lb were more efficient during subsequent periods and overall (Tables 4, 5, 6, 7), but significantly so ($P<.05$) only during the finishing period (Table 5). Effects of rations fed during each period on overall performance and carcass characteristics are summarized in Tables 7, 8 and 9.

These data show that hay is desirable in starter calf rations. However, mixtures containing over 30% hay are not desirable because high fiber rations limit energy intake. The apparent compensatory growth during the growing-finishing period is similar to that observed by Bond et al. (1972) but differs from that reported by Kesler et al. (1975).

TRIAL 2. EFFECTS OF FEEDING 12, 14 AND 16% PROTEIN CALF STARTERS

Procedure

Complete calf starter rations with 20% ground alfalfa hay were formulated to contain 12, 14 or 16% protein. Actual analyses of the starters fed was 11.8, 13.6 and 15.5% protein (13.1, 15.1 and 17.2 on DM basis). The three starter mixtures fed to 400 lb are shown in Table 10.

From 400 to 700 lb, all steers were fed a 4:1 corn silage to concentrate (as-fed basis) mixture. All steers were finished with a 1:1 corn silage: concentrate (as-fed basis) ration. As with the previous hay trial, 1 lb of a urea-containing supplement (Table 2) per steer daily plus rolled shelled corn constituted the concentrate portion of the growing and finishing rations.

Results and Discussion

Daily gains (1.67, 1.80 and 1.88 lb) and feed required per 100 lb of gain (411, 377, 364 lb as-fed) during the period from 93 to about 390 lb were linearly improved ($P<.05$) as protein increased from 13.1 to 15.2 to 17.2% (Table 11). During the growing period (Table 12), when all calves were fed identical rations, there was a negative ($P<.05$) linear relationship on daily gain (2.96, 2.80 and 2.68 lb) and feed per 100 lb gain (1,007, 1,020 and 1,072 lb as-fed) as protein in the starter increased. This relationship continued during the finishing phase (Table 13), but significantly ($P<.05$) so only for feed efficiency. Thus, performance during the entire 385- to 393-day feeding periods (Table 14) did not differ significantly due to protein during the starter period. Carcass data are summarized in Table 15.

NRC (1978, 1984) recommendation for at least 16% protein in calf starters is not supported by these data. Other evidence that protein requirements by calves is less than recommended is shown by Brown et al. (1938), Hibbs and Conrad (1958), Gardner (1968), Daniels and Flynn (1971) and Morrel and Milton (1973). This trial illustrates the need to determine effects of starter diets on performance during the entire feeding period.

TRIAL 3. SUPPLEMENTAL NITROGEN SOURCES FOR STARTER CALVES

Procedures

Complete calf starters were formulated with 20% ground alfalfa hay to provide 14% protein or equivalent nitrogen from urea. Soybean meal provided the supplemental protein in the control diet. In the other three treatments, one-third, two-thirds or all of the protein from soybean meal was replaced by urea. For half the calves, only soybean meal-supplemented diets were offered the first 83 days, after which urea-supplemented diets were fed. The other half were fed their respective rations from 5 to 7 days of age. The starter rations were fed until the average pen weight was 400 lb; then all pens of cattle were grown and finished as in Trial 2 (a 4:1 silage to concentrate ration was fed to 700 lb and a 1:1 silage to concentrate finishing ration was fed to market). Starter mixtures fed are described in Table 16 and urea supplement fed after 400 lb are those described in Table 2 for silage rations.

Results and Discussion

During the starter phase (Table 17) when the experimental rations were fed, average daily gain, daily feed intake and feed required per 100 lb gain did not differ significantly. However, there was a trend toward lower performance as percentage of urea in the ration increased. From 390 lb to market weight (Table 18), when all steers were fed the same growing and finishing rations, differences were again small, but trends were in the opposite direction.

For the entire feeding (Table 19) average daily gains were 2.33, 2.32, 2.30 and 2.29 lb/day for calves fed rations to 390 lb with 0, 33, 67 or 100% of supplemental nitrogen from urea, respectively. There were linear ($P<.01$) reductions in dry matter intake and feed required per unit gain for the entire feeding period as urea increased in starter diets.

No differences in performance were found at any stage between calves started on urea at 1 week of age compared to those started 83 days later. These data indicate that young calves utilize urea and support conclusions from NRC (1976), Brown et al. (1956, 1960), Wallenius and Murdock (1977), but differ from those of Stabo et al. (1967). When corn grain constituted a major portion of the ration, protein requirements appeared to be met by urea. Carcass data are summarized in Table 20.

TRIAL 4. SOURCES OF SUPPLEMENTAL NITROGEN FOR STARTER HOLSTEIN CALVES

Procedure

Although the rumen of the young calf is in the developing stage, previous studies showed that the young calf utilizes urea. Protein from various sources is degraded at different rates in the rumen. To further study the utilization of proteins by the calf with a developing rumen, several sources of supplemental nitrogen were used.

Six complete calf starter diets were full-fed to Holstein male calves from about 94 to 400 lb. Compositions of these diets are presented in Table 21 and analyses, in Table 22. Supplemental nitrogen was supplied from: none (negative control), urea, soybean meal (SBM), formaldehyde-treated soybean meal (F-SBM), distillers dried grains (DDG) and meat meal (MM).

From 400 to 700 lb, all groups were fed the 4:1 ration (4 parts corn silage to 1 part corn and supplement) and then finished with the 1:1 corn silage ration (as-fed basis).

Results and Discussion

During the starter phase (Table 23), negative control steers gained slower (P<.05) than all others, 1.41 vs. 1.71 to 1.96 lb per day. Steers fed DDG gained slower (1.71 lb) than those fed F-SBM (1.88 lb), MM (1.88 lb) or SBM (1.96 lb) (P<.05). Those fed urea gained slower (1.74 lb) than those fed SBM (P<.05). Negative control steers were less efficient (391 vs. 275 to 322 lb feed per 100 lb gain) than all other groups (P<.01).

After the treatment period, all groups performed in a similar manner (Table 24). For the entire feeding period (Table 25), steers fed without protein supplement during the starter phase (negative control) gained at a slower rate (P<.01) than all other groups. Carcass data are summarized in Table 26.

This study shows that calf starters should contain more protein than the negative control (11.1% protein, DM basis). Although gains differed in the starter phase due to sources of protein, total feeding period performance was similar. Less soluble or high bypass protein sources appeared to have no advantage for the starter calf. This trial, like the previous trial, shows that the starter calf utilizes urea as a source of supplemental nitrogen.

GROWING AND FINISHING TRIALS

TRIAL 5. CONCENTRATE TO FORAGE RATIOS

Procedure

From 1962 to 1970, a series of 12 growing and finishing feeding programs for Holstein steers were tested. Various proportions of ground alfalfa hay and concentrate or corn silage and concentrate were fed from approximately 390 to 750 lb (growing) and from 750 lb to market (finishing). Three or four feeding programs were tested during each subtrial. One ration treatment from the preceding subtrial was included in the next subtrial so that data could be pooled and statistical analyses performed.

When hay was fed, alfalfa was ground and mixed with concentrate and self-fed as a complete ration. This total mixed ration was used to more accurately feed planned proportions of hay and as a convenience for feeding. When corn silage was fed all silage and concentrate was hand-fed at the planned proportions. A predetermined amount of supplement was fed daily and rolled shelled corn added to corn silage to provide planned proportions. Compositions of the various complete hay rations and supplements fed with corn silage are shown in Table 27.

The 12 feeding programs are identified as follows: proportion of concentrate to hay or proportion of concentrate to corn silage (as-fed basis) and percentage of hay or corn silage of total dry matter is also given.

1. 11:1--8.9% hay DM, growing and finishing rations
2. 3:1--24.6% hay DM, growing and finishing rations
3. 1:1--50% hay DM, growing and finishing rations
4. 1:3--75.2% hay DM, growing and finishing rations
5. 1:3--75.2% hay DM, growing ration;
   11:1--8.9% hay DM, finishing ration
6. Corn silage plus 2.4 lb supplement daily--86.2% silage DM, growing and finishing rations
7. Corn silage plus supplement as in 6, growing ration
   11:1--8.9% hay DM (as in 5), finishing ration
8. 1:3--55.4% silage DM plus 1.25 lb supplement daily, growing ration;
   11:1--8.9% hay DM (as in 5), finishing ration
9. 1:3--55.4% silage DM plus 1.25 lb supplement daily, growing and finishing rations
10. 1:3--55.4% silage DM plus 1.25 lb supplement daily, growing and finishing rations
11. 1:3--55.4% silage DM plus 1.25 lb supplement daily, growing ration;
    2:1--16.6% silage DM plus 1.25 lb supplement daily, finishing ration
12. 1:1--28.7% silage DM plus 1.25 supplement daily, growing and finishing rations.

Results and Discussion

Least squares means for feedlot performance and carcass characteristics are shown in Tables 28 and 29. When alfalfa hay provided the forage portion of the ration, steers fed by the two-phase program (treatment 5) gained more rapidly (2.66 vs. 2.00 to 2.46 lb/day), more efficiently (643 vs. 661 to 783 lb DM/100 lb gain) and produced carcasses with higher marbling scores (4.5 vs. 3.79 to 4.29) and higher quality grades (11.0 vs. 9.37 to 10.58) than cattle in treat-ments 2, 3, and 4. Steers on the two-phase program gained faster (2.66 vs. 2.49 lb/day) and produced carcasses comparable to those fed higher energy growing and finishing ration (treatment 1).

Silage feeding programs, treatments 9 to 12, resulted in faster rates of gain (2.76 to 3.07 vs. 2.66 lb/day), more efficient gains (545 to 599 vs. 643 lb DM/100 lb gain) and carcasses that were comparable to treatment 5.

As forage increased and energy decreased, rates of gain, feed efficiency, marbling, fat depth and grade decreased but yield grade increased (treatments 1, 2, 3 and 4 for hay rations and treatments 10 to 12 vs. treatments 6 and 9) for silage rations. Trends were similar for cattle fed higher forage rations during only the finishing period (treatment 4 vs. 5; treatment 9 vs. 10 and 11; treatment 6 vs. 7). These findings agree with those of Lester et al., (1968) and Kesler et al. (1975). The bloat problem with ground alfalfa hay observed by the latter authors was not serious in these trials.

Growing rations with 70 to 80% corn silage DM (treatments 6 and 7) supported limited gains and steers were unable to compensate adequately during the finishing phase (treatment 7 vs. 8, 9, 10, 11). Higher amounts of corn grain in the finishing ration (treatments 7 and 8) showed no advantage over treatments 10 (28.7% corn silage DM) or 11(16.6% corn silage DM). Protein in the hay-containing rations was higher than recommended because components of the mixture (especially the hay) contained more protein than assumed.

Recommended growing-finishing programs, based on a combination of feedlot performance, carcass characteristics and typical feed costs, would be to feed a growing ration of 55 to 60% DM as corn silage and 40 to 45% corn and supplement and then finish with a ration of about 28.7% corn silage DM.

TRIAL 6. STORAGE AND PROCESSING

Procedure

Alternate loads of corn from a picker-sheller were dried immediately or placed in an oxygen-limiting silo. After corn had been stored in the silo for at least 6 weeks, it was dried or fed as high moisture corn. All corn was rolled prior to feeding. Steers were started at an average weight of 445 lb and fed 15 lb corn silage, 1 lb supplement (Table 30) and a full feed of corn daily for 150 days. From 150 days to market (finishing ration), corn silage was reduced to 6 lb daily. The three treatments were: 1) corn dried at harvest, 2) corn dried from the silo or 3) corn fed as high moisture corn.

Results and Discussion

Feedlot performance and carcass data are summarized in Tables 31 and 32. Steers fed corn dried at harvest gained slightly faster (2.69 lb/day) than those fed corn dried from the silo (2.59 lb) or high moisture corn (2.56 lb). Dry matter required per 100 lb gain was similar (606, 629 and 609 lb, respectively). Differences in carcass characteristics were small and quality grades varied from high good to low choice. Treatment means for feedlot performance and carcass traits did not differ significantly.

It appears that choice of corn harvest and storage system should be made considering economics; properly managed systems all provided corn grain that supported similar animal performance.

TRIAL 7. GROUND SOYBEANS AS A PROTEIN SOURCE

Procedure

Steers initially weighing approximately 360 lb were fed 10 lb corn silage, a full feed of rolled shelled corn and 2.5 lb of supplement daily during the entire growing-finishing period. Compositions of the supplements are shown in Table 30. Half of the pens of cattle were fed soybean meal supplement and the other half were fed ground whole soybean supplement.

Results and Discussion

Feedlot performance is shown in Table 33 and carcass data in Table 34.

Average daily gains were nearly equal (2.88 and 2.86 lb) and feed required per 100 lb of gain did not differ significantly ($P>.05$). The reduction of 20 lb of corn consumed per 100 lb of gain by steers fed the ground soybean supplement is probably due to the oil present in the whole beans. Carcass differences were small, inconsistent and not significant. Graders did not detect differences in the nature of carcass fat that could be attributed to feeding whole soybeans. Because ground soybeans appeared equivalent to soybean meal as a protein supplement source for steers, there may be situations when it is economically advantageous to use ground soybeans as a feed rather than marketing them.

OTHER STUDIES

FEEDLOT PERFORMANCE AT VARIOUS BODY WEIGHT

Procedure

Cattle require more feed per unit gain as they become heavier and daily gain slows. The extent of these changes may affect the practicality of feeding steers at heavy weights.

Data from growing-finishing trials previously presented were used to determine growth rates and efficiency of feed use by steers at various weights from 400 lb to market weight. Regression equations were developed to describe daily gain and feed efficiency.

Results and Discussion

Regression equations developed that described expected daily gain and efficiency of feed used by Holstein steers were:

$$\text{Daily gain, lb} = 2.94 + .0012W - .00000162W^2$$
$$\text{Feed/100 lb gain, lb} = 525 - .6214W + .00107W^2$$

where W is body weight.

These equations were used to develop data presented in Table 35. Daily gain declined rapidly after cattle weighed 900 lb. Feed/100 lb gain increased slowly at light weights (34 lb feed/100 lb gain from 400 to 600 lb) and rapidly at heavy weights (163 lb feed/100 lb gain from 1,000 to 1,200 lb). Whether cattle should be fed to heavier weights will depend on feed and non-feed costs, and potential for increased returns resulting from heavier weights and slightly higher grades.

HERITABILITY FOR BEEF TRAITS AND RELATIONSHIPS BETWEEN DAIRY AND BEEF TRAITS

Procedures

Growth and carcass data from 728 Holstein steers whose sires and dams had dairy performance data were used. Steer data were from growing-finishing trials reported previously. One hundred sixty-nine sires and 481 dams were represented.

Dairy traits considered were: sire PD milk and milk fat, and dam's age-adjusted first-lactation deviations from herdmates for milk, milk fat and milk protein production. Beef traits were expressed as deviations from pen mates to remove year, pen, season and ration effects.

A one-way analysis of variance was derived for each beef trait and heritability estimates were calculated for the sire component. Estimates were not made for conformation score, marbling score and grade because sire component values were negative. Using five dairy traits as independent variables and seven beef traits as dependent variables, 35 simple regressions were obtained.

Results and Discussion

Heritability estimates calculated from these data are shown in Table 36. The estimates for rate of gain (.29), internal fat (.50), fat depth (.40) and rib eye area (.30) were similar to or slightly less than estimates from beef steer data (Benyshek, 1981).

Relationships of beef and dairy characteristics are shown in Tables 37 to 41. A significant ($P<.06$) positive relationship was found between dam's milk and milk protein production and her steer progeny rate of gain. No other beefdairy traits were significantly related.

These observations are in agreement with those of others who found low positive relationships between beef and dairy traits (Falkenberg et al., 1968; Tyler, 1970; Sims et al., 1972; Calo et al., 1973b; Gibson et al., 1975; Kesler et al., 1975; Bara, 1981). Conclusions that high milk production need not reduce meat production (Kesler et al., 1975) and that milk production is not antago-nistic to meat production (Martin et al., 1962; Wellington et al., 1971) were supported by these findings. Apparently, factors that contribute to early growth are not the same as those associated with high milk production (Holtz et al., 1961).

EFFECT OF CHRONIC BLOAT ON RATE OF GAIN

Procedure

Soon after the growing-finishing trials were initiated with ground hay, several steers showed various degrees of chronic feedlot bloat. No deaths or near deaths occurred among those affected; however, rate of gain appeared to be depressed.

From March, 1964 to February, 1966, each steer was given a bloat score each morning. Score was: 0, no bloat; 1, slight; 2, moderate; 3, extensive; 4, severe; and 5, terminal. None were scored 5.

Results and Discussion

Results from 85 Holstein steers fed three hay-containing rations and 29 Milking Shorthorn steers fed a hay-containing ration are summarized in Table 42.

Significant ($P<.05$) negative relationships were found between bloat score and daily gain. Correlation coefficients ranged from -.44 to -.67 and regression coefficients showed that daily gain was reduced .24 to 1.02 lb/day per unit increase in bloat score.

Although 43% of the steers (29% of Holsteins and 83% of Shorthorns) were given bloat scores above 0, most did not exhibit bloat for more than a few days. Overall, feeding ground alfalfa hay was not hazardous. This differs from conclusions by Kesler et al. (1975); however, diets fed during these trials contained coarsely ground hay from a mill with a 1-inch screen.

APPENDIX

Table 1. Compositions of Starter Rations Fed From 1 Week of Age to 300 lb.

Ingredient	Ration: All concentrate	15% hay	30% hay
	--------	%	--------
Rolled corn grain	79.90	67.21	54.76
Soybean meal	17.60	15.50	13.27
Ground alfalfa hay	---	15.00	30.00
Dicalcium phosphate	1.45	1.63	1.62
Ground limestone	1.05	.66	.40
Vitamins A and D[a]	+	+	+

[a]150,000 IU vitamin A and 15,000 IU vitamin D/100 lb of ration.

Table 2. Compositions of Grower and Finisher Supplements.

Ingredient	All-concentrate rations		Silage rations	
	Grower	Finisher	Grower	Finisher
	--------	-------- %	--------	--------
Ground corn grain	64.96	58.68	63.26	58.39
Urea	12.00	18.07	17.40	21.62
Dicalcium phosphate	11.90	4.7	17.10	7.41
Ground limestone	10.70	17.8	1.80	12.03
Vitamins A and D	+[a]	+[b]	+[a]	+[b]

[a]1 lb of supplement furnished 20,000 IU vitamin A and 2,000 IU vitamin D.
[b]1 lb of supplement furnished 25,000 IU vitamin A and 2,500 IU vitamin D.

Table 3. Feedlot Performance During the Starter Period.

Item	All concentrate	15% hay	30% hay	Significance
No. steers	67	71	73	
Initial wt., lb	94	94	97	
Final wt., lb	313	323	321	
Days fed	146	141	144	
Daily gain, lb	1.49	1.62	1.56	N.S.
Daily feed, lb dry matter[a]				
Corn grain	3.35	3.57	2.98	
Soybean meal	.74	.82	.72	
Alfalfa hay	---	.80	1.64	
Mineral-vitamin premix	.10	.12	.11	
Total	4.19	5.31	5.45	P<.01
Feed/100 lb gain, lb dry matter[a]				
Corn grain	225	220	191	
Soybean meal	50	51	46	
Alfalfa hay	---	49	105	
Mineral-vitamin premix	7	7	7	
Total	282	327	349	P<.01

[a]Does not include approximately 20 lb dry milk replacer fed each calf.

Table 4. Feedlot Performance During the Growing Period as Affected by Starter Ration and Grower Ration.

Item	Starter Ration: All-concentrate		15% hay		30% hay	
Grower Ration:	All-concentrate	Corn + corn silage	All-concentrate	Corn + corn silage	All-concentrate	Corn + corn silage
No steers	32	35	34	37	34	39
Intial wt., lb	313	313	317	330	321	321
Final wt., lb	575	595	589	605	613	580
Days fed[a]	116	135	116	131	114	120
Daily gain, lb[b]	2.30	2.09	2.38	2.09	2.57	2.18
Daily feed, lb dry matter						
Supplement	.89	.89	.89	.89	.89	.89
Corn grain	9.86	2.47	10.07	2.49	10.43	2.54
Corn silage	---	8.07	---	8.14	---	8.27
Total[c]	10.75	11.43	10.96	11.52	11.32	11.70
Feed/100 lb gain, lb dry matter						
Supplement	39	43	37	43	35	41
Corn grain	429	118	423	119	406	117
Corn silage	---	386	---	389	---	379
Total[d]	486	547	460	551	441	537

[a]Days fed: Significant (P<.01) effect of starter ration (30% hay < all concentrate or 15% hay). Significant (P<.01) effect of grower ration.
[b]Daily gain: Significant (P<.01) effect of starter ration (30% hay > all concentrate or 15% hay). Significant (P<.01) effect of grower ration.
[c]Dry matter intake: Significant (P<.01) effect of grower ration.
[d]Dry matter/100 lb gain: Significant (P<.01) effect of grower ration.

Table 5. Feedlot Performance During Finishing Period as Influenced by Starter, Grower and Finisher Rations.

Item	Starter ration:	All-concentrate				15% hay				30% hay			
	Grower ration:	All-conc.		Silage + corn		All-conc.		Silage + corn		All-conc.		Silage + corn	
	Finisher ration:	All-conc.	Silage + corn	All-conc.	Silage + corn	All-conc.	Silage + corn	All-conc.	Silage + corn	All-conc.	Silage + corn	All-conc.	Silage + corn
No. steers		15	17	19	16	17	17	19	18	18	16	19	20
Initial wt, lb		578	572	592	598	597	581	602	607	602	623	579	581
Final wt, lb		998	998	1018	975	1010	1007	997	1008	1033	1025	1021	1003
Days fed[a]		164	164	150	145	164	167	145	148	154	138	158	149
Daily gain, lb[b]		2.59	2.60	2.86	2.64	2.53	2.55	2.78	2.70	2.79	2.93	2.83	2.82
Daily feed, lb dry matter													
Supplement		.89	.89	.89	.89	.89	.89	.89	.89	.89	.89	.89	.89
Corn grain		14.3	11.5	16.9	13.3	15.0	12.0	16.2	13.9	14.6	12.4	16.1	13.1
Corn silage		---	4.7	---	5.4	---	4.9	---	5.6	---	5.0	---	5.3
Total[c]		15.2	17.1	17.8	19.6	15.9	17.8	17.1	20.4	15.5	18.3	17.0	19.3
Feed/100 lb gain, lb dry matter													
Supplement		34	34	31	34	35	35	32	33	32	30	31	32
Corn grain		553	442	589	502	593	472	583	514	525	423	569	463
Corn silage		---	179	---	203	---	191	---	208	---	171	---	188
Total[d]		587	655	620	739	628	698	615	755	557	624	600	683

[a]Days fed: Significant ($P<.05$) effect of starter ration (30% hay < all concentrate or 15% hay).
Significant ($P<.01$) effect of grower ration.

[b]Daily gain: Significant ($P<.05$) effect of starter ration (30% hay > all concentrate or 15% hay).

[c]Daily feed: Significant ($P<.01$) effect of grower ration.
Significant ($P<.01$) effect of finisher ration.

[d]Dry matter/100 lb gain: Significant ($P<.05$) effect of starter ration (30% hay < all concentrate or 15% hay).
Significant ($P<.05$) effect of grower ration.
Significant ($P<.01$) effect of finisher ration.

Table 6. Comparisions of 12 Feeding Programs from 1 Week of Age to Market on Feedlot Performance and Carcass Characteristics.

Item	All-concentrate				15% hay				30% hay			
Starter ration:	All-concentrate				15% hay				30% hay			
Grower ration:	All-conc.		Silage + corn		All-conc.		Silage + corn		All-conc.		Silage + corn	
Finisher ration	All-conc.	Silage + corn	All-conc.	Silage + corn	All-conc.	Silage + corn	All-conc.	Silage + corn	All-conc.	Silage + corn	All-conc.	Silage + corn
No. steers	15	17	19	16	17	17	19	18	18	16	19	20
Initial wt, lb	98	90	98	94	100	95	93	90	96	100	95	98
Final wt, lb	998	998	1018	975	010	1007	997	1008	1033	1025	1021	1003
Days fed	418	433	428	431	413	429	418	424	411	393	422	416
Daily gain, lb	2.17	2.10	2.15	2.04	2.21	2.14	2.17	2.17	2.27	2.36	2.21	2.18
Daily feed, lb dry matter												
Corn grain	9.44	8.19	7.81	6.37	9.92	8.51	7.61	6.90	9.58	8.31	7.72	6.55
Alfalfa hay	---	---	---	---	.27	.25	.27	.29	.55	.61	.61	.55
Soybean meal	.23	.28	.26	.25	.28	.26	.28	.30	.24	.27	.27	.24
Supplement (grower)	.25	.24	.28	.28	.24	.25	.28	.28	.25	.25	.25	.26
Supplement (finisher)	.35	.33	.31	.30	.35	.34	.31	.31	.34	.31	.33	.33
Corn silage	---	1.75	2.55	4.35	---	1.87	2.57	4.46	---	1.72	2.31	4.30
Total	10.27	10.79	11.21	11.55	11.06	11.48	11.32	12.54	10.96	11.47	11.49	12.23
Feed/100 lb gain, lb dry matter												
Corn grain	435	390	363	312	449	398	351	320	422	352	349	300
Alfalfa hay	---	---	---	---	12	12	12	13	24	26	28	25
Soybean meal	11	13	12	12	13	12	13	14	11	11	12	11
Supplement (grower)	12	11	13	14	11	12	13	13	11	11	11	12
Supplement (finisher)	16	16	14	15	16	16	14	14	15	13	15	15
Corn silage	---	83	119	213	---	87	118	206	---	73	105	197
Total	474	513	521	566	501	537	521	580	483	486	520	560
Carcass characteristics												
Marbling score	4.1	4.2	4.4	4.3	4.2	4.6	4.4	4.2	4.6	4.0	4.2	4.0
Conformation score	9.2	9.1	9.4	9.6	9.3	9.2	9.5	9.3	9.7	9.6	9.5	9.4
KHP %	2.5	2.5	2.7	2.7	2.6	2.7	2.6	2.9	2.7	2.6	2.6	2.6
Rib eye area, sq in	10.6	10.4	9.9	10.5	10.1	10.4	10.1	10.1	9.8	10.6	10.0	9.9
Fat depth, in	.38	.35	.49	.40	.32	.38	.39	.30	.44	.32	.39	.42
Quality grade	10.1	10.0	10.7	10.6	10.3	11.0	10.4	10.2	10.6	10.2	10.6	9.5
Yield grade	2.8	2.8	3.3	2.9	2.8	2.9	3.0	2.8	3.2	2.7	3.0	3.2

Table 7. Effects of Ration Fed During the Starter Period on Total Feedlot Performance and Carcass Characteristics.

Item	All-concentrate	15% hay	30% hay	Significance
No. steers	67	71	73	
Initial wt., lb	94	94	97	
Final wt., lb	997	1005	1021	
Days fed	428	421	410	P<.01
Daily gain, lb	2.12	2.17	2.26	P<.05
Daily feed, lb dry matter[a]				
Corn grain	7.95	8.24	8.04	
Alfalfa hay	---	.27	.58	
Soybean meal	.26	.28	.26	
Supplement (grower)	.26	.26	.25	
Supplement (finisher)	.32	.33	.33	
Corn silage	2.16	2.22	2.08	
Total	10.95	11.60	11.54	P<.01
Feed/100 lb gain, lb dry matter				
Corn grain	375	380	356	
Alfalfa hay	---	12	26	
Soybean meal	12	13	11	
Supplement (grower)	12	12	11	
Supplement (finisher)	15	15	14	
Corn silage	104	103	94	
Total	518	535	512	N.S.
Carcass characteristics				
Marbling score	4.26	4.34	4.21	N.S.
Conformation score	9.34	9.33	9.56	N.S.
KHP %	2.62	2.71	2.65	N.S.
Rib eye area, sq. in.	10.4	10.2	10.0	N.S.
Fat depth, in	.40	.35	.39	P<.05
Quality grade	10.37	10.48	10.22	N.S.
Yield grade	2.94	2.88	3.03	N.S.

Table 8. Effects of Ration Fed During the Growing Period on Total Feedlot Performance and Carcass Characteristics.

	All-concentrate	Corn grain + corn silage	Significance
No. steers	100	111	
Initial wt., lb	95	95	
Final wt., lb	1012	1004	
Days fed	416	423	P<.05
Daily gain, lb	2.21	2.15	N.S.
Daily feed, lb dry matter			
Corn grain	8.99	7.16	
Alfalfa hay	.28	.29	
Soybean meal	.26	.27	
Supplement (grower)	.25	.27	
Supplement (finisher)	.34	.32	
Corn silage	.89	3.42	
Total	11.01	11.73	P<.01
Feed/100 lb gain, lb dry matter			
Corn grain	408	332	
Alfalfa hay	12	13	
Soybean meal	12	12	
Supplement (grower)	11	13	
Supplement (finisher)	15	14	
Corn silage	40	160	
Total	498	544	P<.01
Carcass characteristics			
Marbling score	4.28	4.26	N.S.
Conformation score	9.36	9.46	N.S.
KHP %	2.63	2.69	N.S.
Rib eye area, sq. in.	10.3	10.1	N.S.
Fat depth, in	.36	.40	N.S.
Quality grade	10.39	10.33	N.S.
Yield grade	2.87	3.03	P<.05

Table 9. Effects of Ration Fed During the Finishing Period on Total Feedlot Performance and Carcass Characteristics.

	All-concentrate	Corn grain + corn silage	Significance
No. steers	107	104	
Initial wt., lb	96	94	
Final wt., lb	1013	1003	
Days fed	418	421	N.S.
Daily gain, lb	2.20	2.17	N.S.
Daily feed, lb dry matter			
Corn grain	8.68	7.47	
Alfalfa hay	.28	.28	
Soybean meal	.26	.27	
Supplement (grower)	.26	.26	
Supplement (finisher)	.33	.32	
Corn silage	1.24	3.08	
Total	11.05	11.68	P<.01
Feed/100 lb gain, lb dry matter			
Corn grain	395	345	
Alfalfa hay	13	13	
Soybean meal	12	12	
Supplement (grower)	12	12	
Supplement (finisher)	15	15	
Corn silage	57	143	
Total	504	540	P<.01
Carcass characteristics			
Marbling score	4.32	4.22	N.S.
Conformation score	9.44	9.38	N.S.
KPH, %	2.63	2.69	N.S.
Rib eye area, sq. in.	10.1	10.3	N.S.
Fat depth, in	.40	.36	N.S.
Quality grade	10.45	10.27	N.S.
Yield grade	3.03	2.87	P<.05

Table 10. Compositions of Starter Rations Fed From 1 Week of Age to About 390 lb.

Ingredient	Protein, % of dry matter 13.1	15.1	17.2
		%	
Rolled corn grain	73.2	68.3	63.2
Soybean meal (47.5%)	4.0	9.0	14.2
Ground alfalfa hay	20.0	20.0	20.0
Dicalcium phosphate	1.8	1.7	1.6
Ground limestone	.5	.5	.5
Trace mineralized salt	.5	.5	.5
Vitamin premix[a]	+	+	+

[a]150,000 IU vitamin A and 15,000 IU vitamin D/100 lb ration.

Table 11. Influence of Dietary Protein Percentage During the Starter Period on Performance of Holstein Steer Calves During the Starter Period.

Ingredient	Protein, % of dry matter 13.1	15.1	17.2
No. steers	37	36	35
Initial weight, lb	90.2	91.7	96.4
Days on feed	174	165	158
Final weight, lb	380.8	388.7	393.4
Avg. daily gain, lb[a]	1.67	1.80	1.88
Avg. daily feed, lb as fed[b]	6.84	6.77	6.84
Feed/100 lb gain, lb as fed[ab]	411	377	364

[a]Significant linear relationships between protein level and daily gain and feed/100 lb gain ($P<.05$).

[b]Does not include approximately 20 lb of dry milk replacer fed each calf.

Table 12. Influence of Dietary Protein Percentage During the Starter Period on Performance of Holstein Steer Calves During the Growing Period.

	Protein, % of dry matter		
Ingredient	13.1	15.1	17.2
No. steers	37	36	35
Initial weight, lb	381.4	388.3	394.6
Days on feed	103	106	108
Final weight, lb	686.3	685.1	684.0
Avg. daily gain, lb[a]	2.96	2.80	2.68
Avg. daily feed, lb as fed			
Corn grain	5.26	5.03	5.06
Corn silage	23.26	22.30	22.52
Supplement	1.06	1.00	1.00
Total	29.58	28.33	28.58
Feed/100 lb gain, lb as fed			
Corn grain	178	180	189
Corn silage	793	804	846
Supplement	36	36	37
Total[a]	1007	1020	1072

aSignificant linear relationships between protein level and daily gain and feed/100 lb gain ($P<.05$).

Table 13. Influence of Dietary Protein Percentage During the Starter Period on Performance of Holstein Steer Calves During the Finishing Period.

	Protein, % of dry matter		
Ingredient	13.1	15.1	17.2
No. steers	37	36	35
Initial weight, lb	683.5	683.9	685.8
Days on feed	116	119	119
Final weight, lb	1016.4	1018.3	1010.7
Avg. daily gain, lb[a]	2.87	2.81	2.73
Avg. daily feed, lb as fed			
Corn grain	14.60	14.68	14.60
Corn silage	14.59	14.66	14.58
Supplement	1.00	1.00	1.00
Total	30.19	30.34	30.18
Feed/100 lb gain, lb as fed			
Corn grain	509	523	535
Corn silage	510	524	535
Supplement	35	36	37
Total[a]	1054	1083	1107

aSignificant linear relationships between protein level and daily gain and feed/100 lb gain ($P<.05$).

Table 14. Influence of Dietary Protein Percentage During the Starter Period on Performance of Holstein Steer Calves for the Total Feedlot Period.

Ingredient	Protein, % of dry matter 13.1	15.1	17.2
No. steers	37	36	35
Initial weight, lb	90.2	91.7	96.4
Days on feed	393	390	385
Final weight, lb	1009.8	1016.0	1008.9
Avg. daily gain, lb	2.34	2.37	2.37
Avg. daily feed, lb as fed			
Calf mix	2.98	2.82	2.76
Corn grain	5.74	5.91	6.00
Corn silage	10.54	10.69	10.96
Supplement	.58	.59	.59
Total	19.84	20.01	20.31
Feed/100 lb gain, lb as fed			
Calf mix	127	119	116
Corn grain	245	248	252
Corn silage	451	451	461
Supplement	25	25	26
Total	848	843	854

Table 15. Influence of Protein Percentage During the Starter Period on Carcass Characteristics of Holstein Steer Calves.

Ingredient	Protein, % of dry matter 13.1	15.1	17.2
No. of carcasses[c]	37	36	35
Carcass weight, lb	595.6	600.7	596.2
Marbling score	4.26[a]	4.23[a]	3.88[b]
Conformation score	10.14	10.20	10.20
KHP, %	2.50	2.63	2.57
Rib eye area, sq in	10.48	10.26	10.16
Fat depth, in	.17	.16	.18
Quality grade	10.76[a]	10.84[a]	9.90[b]
Yield grade	2.22	2.41	2.48

[a,b]Values in the same row with different superscripts differ ($P<.05$).

[c]For marbling score and quality grade, there were data from 32 carcasses in the 13.1% treatment and 30 carcasses in the 15.5% treatment.

Table 16. Compositions of Starter Rations Fed From 95 to About 390 lb.

Ingredient	Supplemental nitrogen source: Soybean meal	2/3 SBM 1/3 Urea	1/3 SBM 2/3 Urea	Urea
	%			
Rolled corn	68.4	71.5	73.9	76.25
Soybean meal	9.0	5.45	2.7	---
Urea	---	.45	.8	1.15
Alfalfa, ground	20.0	20.0	20.0	20.0
Dicalcium phosphate	1.6	1.6	1.6	1.6
Ground limestone	.5	.5	.5	.5
Trace mineralized salt	.5	.5	.5	.5
Sulfur	---	10g	15g	20g
Vitamin premix	13g	13g	13g	13g

Table 17. Performance of Holstein Steers During the Starter Period.

Item	Time treatment initiated	Supplemental nitrogen source: Soybean meal	2/3 SBM 1/3 Urea	1/3 SBM 2/3 Urea	Urea	SE
No. of pens						
	7 days old	4	4	4	4	
	83 days old	4	4	4	4	
	Total	8	8	8	8	
No. steers						
	7 days old	22	23	23	22	
	83 days old	22	23	24	20	
	Total	44	46	47	42	
Initial weight, lb						
	7 days old	92.8	95.0	95.8	89.7	
	83 days old	93.0	93.7	91.3	97.7	
	Average	92.9	94.4	93.6	93.7	
Days fed						
	7 days old	154.5	158.0	156.2	168.5	
	83 days old	149.5	152.8	154.5	156.2	
	Average	152.0	155.4	155.4	162.4	
Daily gain, lb						
	7 days old	1.90	1.87	1.87	1.76	
	83 days old	1.98	1.94	1.90	1.86	
	Average	1.94	1.90	1.88	1.81	.062
Daily feed						
	7 days old	6.06	6.14	5.96	5.90	
	83 days old	6.18	6.32	6.11	6.03	
	Average	6.12	6.23	6.04	5.97	.11
Feed/100 lb gain, lb DM						
	7 days old	319	329	318	336	
	83 days old	313	326	322	324	
	Average	316	327	320	330	7.64

Table 18. Performance of Holstein Steers During Growing and Finishing Periods Following the Feeding of Various Nitrogen Sources.

Item	Time treatment initiated	Soybean meal	2/3 SBM 1/3 Urea	1/3 SBM 2/3 Urea	Urea	SE
		Supplemental nitrogen source				
No. steers						
	7 days old	22	23	23	22	
	83 days old	22	23	24	20	
	Total	44	46	47	42	
Starting weight for this period						
	7 days old	386.4	390.5	387.9	386.3	
	83 days old	389.0	390.1	384.8	388.2	
	Average	387.7	390.3	386.4	387.2	
Market weight						
	7 days old	1019.2	1028.0	1014.0	1013.0	
	83 days old	1016.4	1030.6	1025.8	1021.4	
	Average	1017.8	1039.3	1019.9	1017.2	
Days fed this period						
	7 days old	243.2	241.8	233.0	236.2	
	83 days old	238.0	241.8	243.5	238.3	
	Average	240.6	241.8	238.2	237.2	
Daily gain, lb						
	7 days old	2.57	2.60	2.60	2.64	
	83 days old	2.57	2.59	2.56	2.60	
	Average	2.57	2.60	2.58	2.62	.085
Daily feed, lb DM						
	7 days old					
	Supplement	.88	.88	.88	.88	
	Corn grain	8.76	8.81	8.64	8.72	
	Corn silage	6.78	6.67	6.72	6.81	
	Total	16.42	16.36	16.24	16.41	
	83 days old					
	Supplement	.88	.88	.88	.88	
	Corn grain	9.00	9.00	8.28	8.65	
	corn silage	6.87	6.88	6.58	6.73	
	Total	16.75	16.76	15.74	16.26	
	Average					
	Supplement	.88	.88	.88	.88	
	Corn grain	8.88	8.90	8.46	8.69	
	Corn silage	6.83	6.78	6.65	6.77	
	Total	16.59	16.56	15.99	16.34	.19
Feed/100 lb gain, lb dry matter						
	7 days old					
	Supplement	34	34	34	33	
	Corn grain	342	341	333	332	
	Corn silage	264	257	259	258	
	Total	640	632	626	623	
	83 days old					
	Supplement	34	34	34	34	
	Corn grain	350	348	324	333	
	Corn silage	266	265	257	259	
	Total	650	647	615	626	
	Average					
	Supplement	34	34	34	34	
	Corn grain	346	344	329	333	
	Corn silage	265	261	258	259	
	Total	645	639	621	625	15.7

Table 19. Performance of Holstein Steers During Entire Feeding Period From About 94 lb to Market.

Item	Time treatment initiated	Supplemental nitrogen source: Soybean meal	2/3 SBM 1/3 Urea	1/3 SBM 2/3 Urea	Urea	SE
Days fed						
	7 days old	397.8	399.8	389.2	404.8	
	83 days old	387.5	394.5	398.0	394.6	
	Average	392.6	397.2	393.6	399.7	
Daily gain, lb						
	7 days old	2.31	2.31	2.31	2.27	
	83 days old	2.35	2.34	2.30	2.31	
	Average	2.33	2.32	2.30	2.29	.069
Daily feed, lb DM						
	7 days old					
	Calf ration	2.36	2.43	2.40	2.46	
	Supplement	.54	.53	.53	.51	
	Corn grain	5.35	5.32	5.17	5.10	
	Corn silage	4.14	4.03	4.02	3.97	
	Total	12.39	12.31	12.12	12.04	
	83 days old					
	Calf ration	2.37	2.45	2.38	2.38	
	Supplement	.54	.54	.54	.53	
	Corn grain	5.53	5.51	5.06	5.23	
	Corn silage	4.22	4.22	4.02	4.07	
	Total	12.68	12.72	12.00	12.21	
	Average					
	Calf ration	2.37	2.44	2.39	2.42	
	Supplement	.54	.54	.53	.52	
	Corn grain	5.44	5.42	5.12	5.16	
	Corn silage	4.18	4.12	4.02	4.02	
	Total[a]	12.53	12.52	12.06	12.12	.13
Feed/100 lb gain, lb DM						
	7 days old					
	Calf ration	194	196	195	191	
	Supplement	23	23	23	23	
	Corn grain	232	232	224	225	
	Corn silage	179	175	174	175	
	Total	628	626	616	614	
	83 days old					
	Calf ration	201	203	196	192	
	Supplement	23	23	23	23	
	Corn grain	236	236	220	227	
	Corn silage	180	180	175	177	
	Total	640	642	614	619	
	Average					
	Calf ration	198	200	196	193	
	Supplement	23	23	23	23	
	Corn grain	234	234	222	226	
	Corn silage	180	177	175	176	
	Total[a]	635	634	616	618	10.7

[a]Linear ($P<.01$) decline as urea increased.

Table 20. Carcass Characteristics of Holstein Steers Fed Various Amounts of Urea During the Starter Period.

Item	Time treatment initiated	Supplemental nitrogen source: Soybean meal	2/3 SBM 1/3 Urea	1/3 SBM 2/3 Urea	Urea	SE
Carcass wt, lb						
	7 days old	597.9	601.3	586.0	593.5	
	83 days old	591.6	601.0	594.1	593.6	
	Average					
Marbling Score						
	7 days old	3.40	3.04	3.65	3.56	
	83 days old	3.16	3.01	2.62	3.58	
	Average[a]	3.28	3.02	3.14	3.57	1.3
KHP, %						
	7 days old	2.00	2.45	2.05	1.81	
	83 days old	2.19	2.32	1.98	1.72	
	Average[a]	2.10	2.38	2.02	1.76	1.0
Rib eye area, sq in						
	7 days old	10.4	11.3	10.7	10.5	
	83 days old	10.6	10.9	10.9	10.7	
	Average	10.5	11.1	10.8	10.6	1.6
Fat depth, in						
	7 days old	.17	.17	.13	.19	
	83 days old	.19	.18	.16	.19	
	Average	.18	.18	.14	.19	.08
Quality grade						
	7 days old	9.7	10.0	9.6	10.3	
	83 days old	9.7	9.9	9.6	9.4	
	Average	9.7	10.0	9.6	9.8	1.4
Yield grade						
	7 days old	2.28	2.07	2.03	2.22	
	83 days old	2.27	2.23	2.06	2.17	
	Average	2.28	2.15	2.04	2.20	.46

[a]Linear improvement (P<.01) with increasing urea.

Table 21. Compositions of Diets Fed During Starter Period From 94 to About 400 lb.

Ingredient	Supplemental nitrogen source					
	Control	Urea	SBM[a]	F-SBM[b]	DDG[c]	MM[d]
	%					
Rolled corn	86.1	84.4	73.4	73.4	61.3	77.5
Ground alfalfa	10	10	10	10	10	10
Urea	--	1.7	--	--	--	--
SBM[a]	--	--	13	--	--	--
F-SBM[b]	--	--	--	13	--	--
Distillers dried grains	--	--	--	--	25	--
Meat meal	--	--	--	--	--	11
Dicalcium phophate	1.8	1.8	1.6	1.6	1.7	--
Ground limestone	.5	.5	.5	.5	.5	--
Trace mineralized salt	.5	.5	.5	.5	.5	.5
Sulfur, g/100 lb	20	20	--	--	--	--
Vitamin premix	1.0	1.0	1.0	1.0	1.0	1.0

[a]SBM = soybean meal
[b]F-SBM = formaldehyde-treated soybean meal
[c]DDG = distillers dried grains
[d]MM = meat meal

Table 22. Analyses of Starter Diets.

Item	Supplemental nitrogen source[a]					
	Control	Urea	SBM[a]	F-SBM[b]	DDG[c]	MM[d]
Dry matter, %	88.3	88.2	88.4	88.3	88.7	88.7
Crude protein, % of DM	11.1	14.8	15.2	15.8	14.9	15.1

[a]See table 21 for definitions of nitrogen source abbreviations.

Table 23. Performance of Holstein Steers During the Starter Period.

Item	Supplemental nitrogen source[a]						
	Control	Urea	SBM	F-SBM	DDG	MM	SE
No. pens	4	4	4	4	4	4	
No. steers	22	21	22	20	23	22	
Initial wt, lb	95	93	92	94	94	93	
Final wt, lb	375	388	387	390	385	386	
Days fed	199	171	151	158	171	160	
Daily gain, lb[b]	1.41	1.74	1.96	1.88	1.71	1.88	.05
Daily feed, lb DM	5.83	5.89	5.77	5.93	5.48	5.44	.28
Feed/100 lb gain, lb DM[c]	391	322	281	301	305	275	14.08

[a]See table 21 for definitions of nitrogen source abbreviations.

[b]Control steers gained slower ($P<.01$) than all others. Steers fed DDG gained slower ($P<.05$) than those fed F-SBM, MM or SBM.

[c]Control steers required more ($P<.05$) feed/100 lb gain than in other treatments, and steers fed urea required more ($P<.05$) feed/100 lb gain than steers fed meat meal.

Table 24. Performance of Holstein Steers During Growing and Finishing Following the Feeding of Various Nitrogen Sources.

Item	Supplemental nitrogen source[a]						
	Control	Urea	SBM	F-SBM	DDG	MM	SE
No. steers	22	21	22	20	23	22	
Initial wt, lb	375	388	387	390	385	386	
Final wt, lb	992	1023	1033	1009	1020	1010	
Days fed	237	234	243	241	223	229	
Daily gain, lb	2.61	2.72	2.67	2.57	2.85	2.70	.03
Daily feed, lb DM							
Supplement	.89	.89	.89	.89	.89	.89	
Corn grain	8.70	8.26	8.58	8.33	8.92	8.61	
Corn silage	6.77	6.69	6.52	6.55	6.92	6.63	
Total	16.36	15.84	15.99	15.77	16.73	16.13	.15
Feed/100 lb gain, lb DM							
Supplement	35	33	33	35	31	33	
Corn grain	334	304	322	324	314	320	
Corn silage	259	247	245	255	243	247	
Total	628	584	600	614	588	600	6.8

[a]See table 21 for definitions of nitrogen source abbreviations.

Table 25. Performance of Holstein Steers During Entire Feeding Period.

Item	Supplemental nitrogen source[a]						
	Control	Urea	SBM	F-SBM	DDG	MM	SE
No. steers	22	21	22	20	23	22	
Initial wt, lb	95	93	92	94	94	93	
Final wt, lb	992	1023	1033	1009	1020	1010	
Days fed	436	404	394	399	394	389	
Daily gain, lb[b]	2.06	2.31	2.40	2.30	2.35	2.36	.03
Daily feed, lb DM							
Calf ration	2.66	2.49	2.22	2.35	2.38	2.24	
Supplement	.48	.52	.54	.55	.50	.52	
Corn grain	4.73	4.78	5.29	5.03	5.05	5.07	
Corn silage	3.68	3.87	4.02	3.96	3.92	3.91	
Total	11.55	11.66	12.07	11.89	11.85	11.74	.32
Feed/100 lb gain, lb DM							
Calf ration	129	108	93	103	101	95	
Supplement	24	22	23	23	21	22	
Corn grain	230	208	222	219	215	215	
Corn silage	179	168	168	172	167	166	
Total	562	506	506	517	504	498	21.0

[a]See table 21 for definitions of nitrogen source abbreviations.
[b]Control steers gained slower ($P<.01$) than steers in other treatments.

Table 26. Carcass Characteristics of Holstein Steers Fed Various Sources of Nitrogen During the Starter Period.

Item	Supplemental nitrogen source[a]						
	Control	Urea	SBM	F-SBM	DDG	MM	SE
No. carcasses	22	21	22	20	23	22	
Carcass wt, lb	588	588	588	588	588	588	
Marbling score	4.76	4.39	4.80	4.39	4.41	5.03	.08
KHP,%[c]	2.62	3.60	3.56	3.44	3.50	3.53	.07
Rib eye area, sq in	9.74	9.12	9.36	9.54	9.36	9.49	.08
Fat depth, in	.18	.15	.18	.15	.15	.17	.004
Quality grade[d]	11.4	10.4	11.3	10.4	10.4	11.6	.17
Yield grade[b]	2.62	2.89	2.95	2.75	2.72	2.87	.05

[a]See table 21 for definitions of nitrogen source abbreviation.
[b]For KHP and yield grade, numbers of carcasses were 12, 12, 11, 12, 11 and 10 respectively.
[c]Control steers had lower ($P<.01$) KHP values than steers in other treatments.
[d]Steers fed MM graded higher ($P<.05$) than those fed urea, F-SBM and DDG.

Table 27. Compositions of Growing-Finishing Rations With Various Percentages of Hay and of Supplement for Corn Silage Rations.

Ingredient	Hay in ration, % 8.7	24.4	49.3	74.2	Corn Silage supplement
	%				
Ground shelled corn	74.3	61.3	40.8	20.3	--
Soybean meal	15.0	12.5	8.3	4.1	92.0[a]
Dehydrated alfalfa meal	8.7	7.1	4.7	2.4	--
Ground alfalfa hay	--	17.3	44.6	71.8	--
Ground limestone	.4	.3	.2	--	8.0
Dicalcium phosphate	.6	.5	.4	.4	--
Trace mineralized salt	1.0	1.0	1.0	1.0	--

[a]Includes vitamin A premix to supply 16,000 IU/lb of corn silage supplement.

Table 28. Feedlot Performance of Holstein Steers Fed Rations with Various Concentrate to Roughage Ratios.

Treatment no.	1	2	3	4	5	6	7	8	9	10	11	12
Ration (growing)[a]	8.9H	24.6H	50H	75.2H	75.2H	86.2S	86.2S	55.4S	55.4S	55.4S	55.4S	28.7S
Ration (finishing)	8.9H	24.6H	50H	75.2H	8.9H	86.2S	8.9H	8.9H	55.4S	28.7S	16.6S	28.7S
No. steers	48	27	23	28	61	34	59	24	57	28	29	29
No. pens	9	4	4	5	11	6	11	5	10	5	5	5
Initial wt, lb	394	413	406	383	387	389	389	389	387	389	382	384
Final wt, lb	1012	995	912	903	1036	963	1025	1035	1033	1039	1048	1045
Days fed	248	237	238	260	244	276	250	248	234	218	217	217
Average daily gain, lb	2.49	2.46	2.13	2.00	2.66	2.08	2.54	2.60	2.76	2.98	3.07	3.05
Feed intake, lb dry matter/head daily												
Corn grain	11.20	10.50	6.36	3.20	8.21	---	6.02	8.78	6.32	8.94	10.19	10.87
Alfalfa-brome hay	---	2.83	6.93	11.36	6.21	---	---	---	---	---	---	---
Dehydrated alfalfa	1.31	1.17	.74	.39	.97	---	.70	.65	---	---	---	---
Soybean meal	2.26	2.21	1.30	.67	1.67	2.10	2.39	1.79	1.06	1.08	1.09	1.09
Corn silage	---	---	---	---	---	13.14	6.18	4.65	9.17	6.59	5.45	4.81
Total	14.77	16.26	15.33	15.62	17.06	15.24	15.29	15.87	16.55	16.61	16.73	16.77
Feed/100 lb gain, lb dry matter												
Corn grain	449	408	299	160	309	---	237	338	229	300	332	356
Alfalfa-brome hay	---	115	325	569	234	---	---	---	---	---	---	---
Dehydrated alfalfa	53	48	35	20	37	---	28	25	---	---	---	---
Soybean meal	91	90	61	34	63	101	94	69	38	36	35	36
Corn Silage	---	---	---	---	---	632	243	179	332	221	178	158
Total	593	661	720	783	643	733	602	611	599	557	545	550

[a]Figures are percentage hay (H) or corn silage (S) dry matter in total ration.

Table 29. Carcass Characteristics of Holstein Steers Fed Rations with Various Concentrate to Roughage Ratios.

Treatment no.	1	2	3	4	5	6	7	8	9	10	11	12
Ration (growing)[a]	8.9H	24.6H	50H	75.2H	75.2H	86.2S	86.2S	55.4S	55.4S	55.4S	55.4S	28.7S
Ration (finishing)	8.9H	24.6H	50H	75.2H	8.9H	86.2S	8.9H	8.9H	55.4S	28.7S	16.6S	28.7S
No. carcasses	48	27	23	28	61	34	59	24	57	28	29	29
Carcass wt, lb	580.8	580.8	580.8	580.8	580.8	580.8	580.8	580.8	580.8	580.8	580.8	580.8
Marbling score	4.55	4.29	3.79	3.87	4.50	3.93	4.16	4.28	4.20	4.80	4.61	4.87
Conformation score	8.79	8.30	8.21	8.10	8.82	8.75	8.79	9.21	9.38	9.87	9.79	9.75
KHP %	2.26	2.44	2.33	2.12	2.26	2.20	2.17	2.38	2.22	2.18	2.22	2.23
Rib eye area, sq in	10.3	10.1	10.4	10.4	10.0	10.2	10.1	10.0	10.3	10.3	10.5	10.4
Fat depth, in	.36	.35	.26	.28	.36	.29	.31	.33	.33	.38	.34	.38
Quality grade	11.10	10.58	9.37	9.61	11.0	9.79	10.32	10.56	10.40	11.60	11.22	11.71
Yield grade	2.76	2.85	2.51	2.52	2.84	2.57	2.67	2.81	2.68	2.78	2.63	2.77
Cutability, %	50.4	50.2	51.0	51.0	50.2	50.9	50.6	50.3	50.6	50.4	50.7	50.4

[a]Figures are percentage hay (H) or corn silage (S) dry matter in total ration.

Table 30. Compositions of Supplements Used in Corn Handling and Whole Soybean Trials.

	Supplement		
Ingredient	Corn handling	Soybean meal	Ground whole soybeans
	----------	%	----------
Ground shelled corn	52.0	33.3	16.5
Urea (281)	25.0	--	--
Soybean meal (49%)	--	56.0	--
Ground whole soybean	--	--	72.8
Ground limestone	11.0	6.4	6.4
Dicalcium phosphate	3.5	--	--
Elemental sulfur	.4		
Trace mineralized salt	7.5	4.0	4.0
Vitamin premix[a]	.6	.3	.3

[a]To provide 20,000 IU vitamin A/steer daily.

Table 31. Performance of Steers Fed Corn Stored and Processed by Three Methods.

Item	Corn in ration: Corn dried at harvest	Corn dried from silo	High moisture corn
No. steers	21	20	23
Initial weight, lb	444	440	446
Final weight, lb	1045	1054	1017
Days fed	224	240	224
Average daily gain, lb	2.69	2.59	2.56
Average daily feed, lb			
Corn silage	3.62	3.52	3.64
Corn grain	11.68	11.57	10.94
Supplement	0.90	0.90	0.90
Total	16.20	15.99	15.48
Feed/100 lb gain, lb			
Corn silage	136	140	143
Corn grain	436	453	430
Supplement	34	36	36
Total	606	629	609

Table 32. Carcass Data of Steers Fed Corn Stored and Processed by Three Methods.

Item	Corn in ration: Corn dried at harvest	Corn dried from silo	High moisture corn
No. carcasses	15	15	18
Carcass weight	632	632	632
Marbling score	4.86	4.52	4.62
Conformation score	10.26	9.91	10.51
Maturity	2.00	1.92	2.07
KHP, %	2.71	2.63	2.65
Rib eye area, sq in	10.6	10.5	10.7
Fat depth, in	0.43	0.51	0.52
Carcass grade	11.72	11.04	11.24
Yield grade	3.10	3.33	3.30

Table 33. Performance Data of Steers Fed Soybean Meal or Ground Soybeans as Supplemental Protein.

Item	Soybean meal	Ground soybeans
No. steers	23	24
Initial weight, lb	360	360
Final weight, lb	1028	1033
Average days fed	232	236
Average daily gain, lb	2.88	2.86
Average daily feed, lb		
Corn silage	3.61	3.56
Rolled shelled corn	10.57	9.97
Supplement	2.25	2.25
Total	16.43	15.78
Feed/100 lb gain, lb		
Corn silage	125	124
Rolled shelled corn	367	349
Supplement	78	79
Total	570	552

Table 34. Carcass Data of Steers Fed Soybean Meal or Ground Soybeans as Sources of Supplemental Protein.

Item	Soybean meal	Ground soybeans
No. steers	23	24
Carcass weight, lb	605.6	605.6
Marbling score	4.0	4.3
Conformation score	9.9	10.1
KHP, %	2.57	2.42
Rib eye area, sq in	10.3	10.3
Fat depth, in	0.52	0.46
Carcass grade	10.00	10.67
Yield grade	3.31	3.15
Cutability, %	49.1	49.5

Table 35. Performance of Holstein Steers at Various Weights.

Weight, lb	Daily gain, lb	Daily feed, lb as-fed	Feed/100 lb gain, lb as-fed
400 to 500	3.16	14.2	448
500 to 600	3.14	15.1	482
600 to 700	3.08	16.5	537
700 to 800	2.99	18.4	614
800 to 900	2.87	20.5	713
900 to 1000	2.72	22.6	832
1000 to 1100	2.53	24.6	973
1100 to 1200	2.31	26.2	1136

Table 36. Heritability Estimates.[a]

Trait	Heritability	Standard error	95% confidence interval
Gain	.29	± .14	± .27
Internal fat	.50	± .16	± .31
Eat depth	.40	± .15	± .30
Rib eye area	.30	± .14	± .28

[a]Heritability estimates for conformation score, marbling score and quality grade were not calculated because sire component values were negative.

Table 37. Regression Values of Beef Traits on Sire PD Milk.

Dependent variable	Regression coefficient (b)	Standard error	Significance, P<
Rate of gain	-.002	±.013	.79
Conformation score	.009	±.014	.51
Marbling score	-.020	±.013	.13
Internal fat	-.008	±.007	.29
Quality grade	-.004	±.014	.77
Fat depth	.001	±.002	.53
Rib eye area	.001	±.013	.96

Table 38. Regression Values of Beef Traits on Sire PD Fat

Dependent variable	Regression coefficient (b)	Standard error	Significance, P<
Rate of gain	-.439	±.384	.25
Conformation score	.310	±.435	.48
Marbling score	.180	±.409	.66
Internal fat	-.289	±.229	.21
Quality grade	.460	±.438	.29
Fat depth	.046	±.060	.44
Rib eye area	.032	±.425	.94

Table 39. Regression Values of Beef Traits on Dam Deviation Milk.

Dependent variable	Regression coefficient (b)	Standard error	Significance, P<
Rate of gain	.073	±.004	.06
Conformation score	.004	±.004	.35
Marbling score	.003	±.004	.47
Internal fat	-.002	±.002	.47
Quality grade	.006	±.005	.18
Fat depth	.000	±.001	.92
Rib eye area	-.001	±.004	.88

Table 40. Regression Values of Beef Traits on Dam Deviation Fat.

Dependent variable	Regression coefficient (b)	Standard error	Significance, P<
Rate of gain	.139	±.093	.14
Conformation score	.064	±.111	.56
Marbling score	.052	±.102	.61
Internal fat	-.005	±.058	.93
Quality grade	.109	±.110	.32
Fat depth	.011	±.015	.44
Rib eye area	.003	±.102	.98

Table 41. Regression Values of Beef Traits on Dam Deviation Milk Protein.

Dependent variable	Regression coefficient (b)	Standard error	Significance, P<
Rate of gain	.238	±.126	.06
Conformation score	.045	±.141	.75
Marbling score	.037	±.078	.79
Internal fat	-.101	±.078	.20
Quality grade	.058	±.144	.69
Fat depth	.003	±.020	.89
Rib eye area	.019	±.158	.91

Table 42. Effect of Chronic Bloat on Daily Gain.

Item	Ration hay percentage			Milking Shorthorn steers
	74.2	8.7	74.2-8.7	24.4
No. steers	28	27	30	29
No. with bloat	11	7	7	24
Average bloat score	.27	.26	.05	.74
Average daily gain, lb	2.37	2.55	2.81	2.38
r-value (bloat score and ADG)	-.65[a]	-.67[a]	-.46[b]	-.44[b]
Regression coefficient	-.24[a]	-.43[a]	-1.02[b]	-.30[b]

[a]Significant values (P<.01)
[b]Significant values (P<.05)

LITERATURE CITED

Bara, Said. 1981. Direct response to selection for milk yield and correlated responses in traits associated with beef characteristics and milk composition. M.S. Thesis. University of Minnesota.

Benyshek, L.L. 1981. Heritabilities for growth and carcass traits estimated from data on Herefords under commercial conditions. J. Anim. Sci. 53:49.

Bohstedt, G. 1922. Feeding dairy steers. Ohio Agr. Exp. Sta. Bimonthly Bull. 83:193.

Bond, J., N.W. Hooven, Jr., E.J. Warwick, R.J. Hiner and G.V. Richardson. 1972. Influence of breed and plans of nutrition on performance of dairy, dual purpose and beef steers. II -- From 180 days of age to slaughter. J. Anim. Sci. 34:1046.

Branaman, G.A. and G.A. Brown. 1937. Influence of type and age in fattening cattle. Michigan Quart. Bull. 20:14.

Branaman, G.A., A.M. Pearson, W.T. Magee, Ruth M. Griswold and G.A. Brown. 1962. Comparison of the cutability and eatability of beef and dairy type cattle. J. Anim. Sci. 21:321.

Brown, L.D., C.A. Lassiter, J.P. Everett and J.W. Rust. 1956. The utilization of urea nitrogen by young dairy calves. J. Anim. Sci. 15:1425.

Brown, L.D., C.A. Lassiter, J.P. Everett, D.M. Seath and J.W. Rust. 1958. Effect of protein level in calf starters on growth rate and metabolism of young calves. J. Dairy Sci. 41: 1425.

Brown, L.D., Don R. Jacobson, J.P. Everett, D.M. Seath and J.W. Rust. 1960. Urea utilization by young dairy calves as affected by chlortetracycline supplementation. J. Dairy Sci. 43:1313.

Calo, L.L., R.E. McDowell, L.D. Van Vleck and P.D. Miller. 1973a. Parameters of growth of Holstein-Friesian bulls. J. Anim. Sci. 37:417.

Calo, L.L., R.E. McDowell, L.D. Van Vleck and P.D. Miller. 1973b. Genetic aspects of beef production among Holstein-Friesian pedigree selected for milk production. J. Anim. Sci. 37:676.

Cole, J.W., C.B. Ramsey, C.S. Hibbs and R.S. Temple. 1964a. Effect of type and breed of British Zebu and dairy cattle on production, palatability and composition. II - Percent wholesale cuts and yield of edible portion as determined by physical and chemical analysis. J. Anim. Sci. 23:71.

Cole, J.W., C.B. Ramsey, C.S. Hibbs and R.S. Temple. 1964b. The effect of type and breed of beef and dairy cattle on production, carcass composition and palatability. J. Dairy Sci. 47:715.

Daniels, L.B. and C. Flynn. 1971. Evaluation of protein levels in calf starter rations. J. Dairy Sci. 54:788 (Abstr.).

Falkenberg, J.A., H.D. Radloff and R.W. Rice. 1968. Relationships between milk production of Holstein dams and performance of steer progeny. J. Dairy Sci. 51:958.

Fuller, J.G. 1930. Fattening crossbred vs. purebred calves for baby beef. Wisconsin Agr. Exp. Sta. Bull. 410:75.

Gardner, R.W. 1968. Digestible protein requirements of calves fed high energy rations ad libitum. J. Dairy Sci. 51:888.

Gibson, W.D., T.M. Ludwick and E.R. Radar. 1975. Growth of Holstein steers from sires of widely varying predicted differences. J. Dairy Sci. 58:756 (Abstr.).

Hanke, H.E., R.E. Smith, O.E. Kolari, A.J. Harvey, W.J. Aunan and L.E. Hanson. 1964. A comparison of feedlot performance and carcass characteristics of Hereford, Shorthorn and Holstein steers. Mimeo Rpt. MB-4, University of Minnesota.

Hibbs, J.W., H.R. Conrad, W.D. Pounden and Norina Frank. 1956. Influence of hay to grain ratio on calf performance, rumen development and certain blood changes. J. Dairy Sci. 39:171.

Hibbs, J.W. and H.R. Conrad. 1958. High roughage system for raising calves based on the early development of rumen function. VIII - Effect of rumen inoculations and chlortetracycline on performance of calves fed high roughage pellets. J. Dairy Sci. 41:1230.

Hibbs, J.W., E.W. Klosterman, H.R. Conrad, L.E. Kunkle and V.R. Cahill. 1959. Dairy beef production. Ohio Agr. Exp. Sta. Res. Bull. 833.

Holtz, E.W., R.E. Erb and A.S. Hodgson. 1961. Relationship between rate of gain from birth to six months of age and subsequent yields of dairy cows. J. Dairy Sci. 44:672.

Hooven, N.W., Jr., J. Bond, E.J. Warwick, R.L. Hiner and G.V. Richardson. 1972. Influence of breed and plane of nutrition on the performance of dairy, dual purpose and beef steers. I--Birth to 180 days of age. J. Dairy Sci. 34:1037.

Jacobson, N.L. 1969. Energy and protein requirements of the calf. J. Dairy Sci. 52:1316.

Jahn, E., P.T. Chandler and C.E. Polan. 1970. Effects of fiber and ratio of starch to sugar on performance of ruminating calves. J. Dairy Sci. 53:466.

Jahn, E. and P.T. Chandler. 1976. Performance and nutrient requirements of calves fed varying percentages of protein and fiber. J. Anim. Sci. 42:724.

Kesler, E.M., J.H. Ziegler, J.M. Wilson, J.L. Walkins and J.M. Buckalew. 1975. Studies on dairy beef production using male Holsteins. Pennsylvania Agr. Exp. Sta. Bull. 802.

Kidwell, J.F. and J.A. McCormick. 1956. The influence of size and type on growth and development of cattle. J. Anim. Sci. 15:109.

Lester, E.E., D.P. Heaney and W.J. Pigden. 1968. Performance of HolsteinFriesian steers fed an all concentrate ration diluted with ground hay. J. Dairy Sci. 51:1947.

Martin, T.G., N.L. Jacobson, L.D. McGilliard and P.G. Homeyer. 1962. Factors related to weight gain of dairy calves. J. Dairy Sci. 45:886.

Mason, I.T. 1964. Genetic relation between milk and beef characteristics in dual-purpose cattle breeds. Anim. Prod. 6:31.

Matsushima, J., P.A. Anderson, A.L. Harvey and W.J. Aunan. 1949. Variation in fattening performance of typical beef, dairy and dual purpose steers. J. Anim. Sci. 8:613.

Morrill, J.L. and S.L. Melton. 1973. Protein required in starters for calves fed milk once or twice daily. J. Dairy Sci. 56:927.

NRC. 1976. Urea and other non-protein nitrogen compounds in animal nutrition. National Academy of Sciences, National Research Council, Washington, D.C.

NRC. 1978. Nutrient requirements of dairy cattle. National Academy of Sciences, National Research Council, Washington, D.C.

NRC. 1984. Nutrient requirements of beef cattle. National Academy of Sciences, National Research Council, Washington, D.C.

Nichols, J.R. and J.M. White. 1964. Symposium: Dairy beef. J. Dairy Sci. 47:1149.

Sims, J.A., J.M. Leuenberger and J.L. Reaves. 1972. Feeding out young dairy bulls for beef. J. Dairy Sci. 55:686 (Abstr.).

Suess, G.G., W.J. Tyler and V.H. Brungardt. 1968. Relationship between carcass characteristics of Holstein steers and genetic level for milk production. J. Anim. Sci. 27:972.

Stabo, I.J.F., F.H.B. Roy and H.J. Gaston. 1967. The protein requirements of the ruminant calf. III--The ability of the calf weaned at 15 weeks of age to utilize urea as a supplement to low protein concentrate. Anim. Prod. 9:165.

Touchberry, R.W. 1951. Genetic correlations between five body measurements, weight, type and production in the same individual among Holstein cows. J. Dairy Sci. 34:342.

Tyler, W.J. 1970. Relationship between growth traits and production of milk and meat. J. Dairy Sci. 53:830.

Wallenius, R.W. and E.R. Murdock. 1977. Protein levels for calves on limited milk-early weaning program. J. Dairy Sci. Suppl. I:71 (Abstr.).

Wellington, G.H., J.W. Stiles, T.G. Martin, S.B. Guss, L.C. Hallman, Jr., J.H. Ziegler, L.L. Wilson, D.S. Cobb and W.N. Garrett. 1971. Dairy beef symposium and symposium beef production form dairy cattle. J. Anim. Sci. 32:424.