UNIVERSITY OF MINNESOTA
Extension
SERVICE

Department of
Animal Science

205 Haecker Hall
1364 Eckles Avenue
St. Paul, MN 55108-6118

Beef Cattle Management Update

HOLSTEIN FEEDING PROGRAMS

Issue 35
February 1996

H. Chester-Jones
Southern Experiment Station, Waseca

A. DiCostanzo
Department of Animal Science, St. Paul

Introduction

Feeding Holstein steers can be subdivided into distinct segments that provide management opportunities for the dairy farmer feeder or specialized feedlot operator to identify a niche that fits available feed resources, labor, facilities and marketing options. The ultimate goal is production of a finished steer between 12 and 14 months old. Interim production phases include pre-weaning (typically 28 to 35 days), weaning through growing (between 300 and 600 lb) and a finishing period in commercial feedlots or retained ownership on a dairy farm.

Market options for Holstein calves include: young calves 3 to 14 days old, sold directly off the dairy farm or through sale barn auctions; started calves, post weaned, 180 to 225 lb; light feeder steers, 350 to 400 lb; feeder steers from 500 to 700 lb; heavy feeders from 900 to 1000 lb; and finished steers marketed at 1150 to 1300+ lb, depending on the previous feeding regimen. Feeding strategies should optimize the excellent growth characteristics of the young Holstein calf to provide a potential base for an economic return. The purpose of this paper is to outline feeding options for young Holstein calves and growing-finishing steers that will provide a basis for producers to choose a program that is the most profitable for their specific labor, feed resources and facility limitations.

Some Comparative Differences Between Holstein and Beef Breed Steers

a) Holsteins require 10 to 12% more energy for maintenance than beef breeds. Feeding high energy diets to Holstein steers increase production efficiency as the proportion of energy consumed for maintenance is reduced.

b) Holstein steers use feed energy more efficiently for protein and less efficiently for fat deposition than beef breeds. Energy, protein and fat content of gain vary less with rate of gain than with body type. A USDA low choice grade is reached at an average fat content of 28.8% corresponds to a 1250-lb large frame Holstein steer, 1050-lb medium frame and 900-lb small frame beef steer.

c) Minnesota feedlot research has shown Holsteins require 8 to 10% more feed per unit gain over the entire feeding period than smaller frame beef breeds. These feedlot trials also indicated Holstein steers consume 7% more dry matter than beef steers.

d) Holstein steers have less muscling than beef breeds, greater ability to marble with less external fat but a lower dressing percentage. Typically, beef breeds such as Angus will have a greater marbling score, rib-eye area and quality grade than Holsteins at the same live weight.

e) Holstein steers respond with greater gains to high grain diets than beef steers.

f) Holstein steers are less adaptable to environmental stress due to having less hair, external fat and thinner hide. Mud, wind, rain and snow appear to affect Holstein steers more than beef breed steers. Beef breed steers perform well in open lots as long as windbreaks and mounds are provided, but performance of Holstein steers may suffer during the winter in these facilities. For optimum feedlot performance Holstein steers should have access to a three sided barn with a naturally ventilated roof. Holstein steers should be able to get out of the mud at all times.

Estimates of daily nutrient requirements for energy, protein, calcium and phosphorus at varying rates of gain by Holstein calves from 100 to 1320 lb live weight are summarized in Table 1. These are guidelines that can be used to formulate rations at different phases of production. Feedlot performance utilizing these guidelines may vary under different environmental conditions. Following short periods of environmental stress, animals may have the ability to compensate and maintain overall expected growth rates.

Table 1. Examples of daily nutrient requirement estimates for large frame Holstein calves from 100 to 1320 lb body weight adapted from NRC for dairy (1989) and beef (1984)

Live weight, lb	Gain, lb/day	Energy, Mcal/ day		Crude protein, lb	Minerals, g/day	
		NE_m	NE_g		Ca	P
100	1.1	1.50	.60	.57	8	5
120	1.1	1.73	.84	.70	11	7
165	1.8	2.20	.98	.80	23	10
	2.2	2.20	1.26	.90	28	11
	2.6	2.20	1.54	1.10	33	13
220	1.8	2.72	1.22	1.00	25	11
	2.2	2.72	1.56	1.10	30	12
	2.6	2.72	1.90	1.30	35	14
330	2.2	3.69	2.11	1.48	33	14
	2.6	3.69	2.57	1.63	38	16
	3.1	3.69	3.06	1.78	44	18
440	2.6	4.57	3.20	1.72	37	17
	3.1	4.57	3.80	1.86	42	18
	3.5	4.57	4.40	1.97	47	20
660	2.6	6.20	4.34	1.89	35	18
	3.1	6.20	5.14	2.00	38	20
	3.5	6.20	5.95	2.08	42	21
880	2.6	7.69	5.38	2.05	33	20
	3.1	7.69	6.38	2.13	36	21
	3.5	7.69	7.38	2.18	38	22
1100	2.6	9.09	6.37	2.19	31	22
	3.1	9.09	7.54	2.25	33	22
1320	2.2	10.43	5.98	2.25	28	23
	2.6	10.43	7.30	2.32	30	24

Feeding Strategies by Production Phase

Phase 1: Pre-weaning to 400 lb:

Selection of uniform, healthy calves between 90 and 110 lb is a key to efficient production systems. This production phase is the most labor intensive. The pre-weaning period is the most critical where mortality, morbidity, and overhead costs are high compared to the remainder of the growing-finishing phases. Purchasing calves through an order buyer offers a greater chance to obtain uniform calf groups than relying on dairy farms where calving patterns dictate calf availability. Management of calves immediately after birth should be optimal whether calves are being retained on dairy farms or sold at 3 to 14 days old. The variability of management after birth has resulted in many calves being immunologically deficient and, when they are co-mingled from different sources, they are at a high health risk status. Key points to remember for all calves are:

- At least 2 quarts (preferably 3 to 4 quarts) of high quality colostrum within 30 minutes after birth and another 2 quarts within 8 to 12 hours.
- Dip navel of calf with strong iodine; administer calf vaccines and supplementary vitamins when appropriate; put identification tag in the calf's ear.
- Keep maternity area clean, dry and sanitized.
- Sanitize and clean individual housing for calves (hutches, stalls, crates) prior to moving calf within 24 hours after birth.

Conditioning Schedules for Purchased Calves from 1 Week to 8 to 10 Weeks 0ld:

Purchased calves may offer additional challenges. Prior to accepting calves, check for wet navels, navel infections, injuries, deformities, lameness, scours, dehydration, eye and ear problems, pneumonia, contracted tendons and, if possible, screen for low serum proteins or immunoglobulin G levels (Boomer, 1993). An example of a schedule used at the Southern Experiment Station (SES) with suggested modifications adapted for many commercial operations by Kansas veterinarian, Gene Boomer, is as follows:

1. Pre-arrival:

- Clean and sanitize stalls, hutches or crates.
- Have good supply of electrolytes/glucose product on hand.
- Have a rectal thermometer available to check calves.
- Have plenty of help to unload calves quickly.

2. First 24 to 48 hours after arrival (SES system):

- Weigh calves off the truck, make sure each calf has an ear tag, and place in individual stalls, etc.
- Prepare a calf record card.
- Feed 4 ounces of electrolyte/glucose in 2 quarts warm water for first 2 feedings.
- Within 24 hours: intranasal vaccine for IBR and PI3, intramuscular-muscular injections of vitamins A, D, E (+selenium), B-complex and iron (all calves receive an oral rota-corona vaccine prior to pick up).
- Antibiotic treatments given every other day during the first week.
- 3rd feeding onwards: a good quality milk replacer from 6 ounces in 2 quarts of water up to a maximum of 8 ounces twice daily. Milk replacer (MR) preferably should contain a coccidiostat.

- Check for listless and droopy calves; treat calves with bloody scours.

Modifications to consider: upon arrival, dip navels of calves with strong iodine; do not vaccinate immediately for IBR, PI3, BVD or BRSV; a first feeding of electrolytes -- then 6 hours after arrival, 6 ounces of MR in 3 pints of 105°F water -- repeat 18 hours after arrival. Consider using amprolium as an alternative coccidiostat if one is not incorporated in the MR.

3. 48 hours to weaning (SES system):

- Keep fresh water available at all times in front of the calves.
- Day 2: offer a coarse textured calf starter (17 to 18% crude protein) that contains a coccidiostat.
- Use techniques to encourage dry feed intake; offer fresh feed daily.
- Ideally calves should consume 40+ lb of original starter before being moved to another program, such as whole corn:pellet option. Use a 3-day transition just prior to or after weaning for dietary changes.
- Calves are weaned after 28 days if consuming 1½ to 2 lb of dry feed/day.
- Calves receive a single dose of a BRSV vaccine 21 days after arrival.
- Expect some general diarrhea in 30 to 40% of calves during the first two weeks; in the second two weeks up to 20% of calves may have respiratory problems. Use electrolytes + glucose solution to treat scours and prevent dehydration. Also administer anti-bacterial scour tablets such as Bactrin. Calves with chronic respiratory problems should be culled as soon as possible.

Modifications to consider: treat all navels with iodine again on day 3; wait until day 7 to administer first vaccination (modified live) for bovine respiratory complex (BRC) and BVD. Castrate and de-horn prior to weaning; e.g., on day 14, de-worm calves and administer an intranasal IBR and PI3 vaccine during week 4 after arrival prior to weaning. Wean calves when consuming at least 2 lb of dry feed on 3 consecutive days.

4. Weaning to 8 to 10 weeks after arrival (SES system):

- Castrate, de-horn and implant calves within two weeks after weaning, but not all on the same day.
- Continue calves on full feed daily.
- De-worm and weigh calves, then transfer to group pens of 6 to 8.
- In winter, adjust temps inside calf rooms downwards prior to transfer.

Modifications to consider: re-vaccinate calves for BRC and BVD and implant during week 7; keep in individual stalls/pens for 10 to 14 days after weaning. Then, if possible, move calves into small group pens of 3 calves/pen. During week 9, transfer calves to pens of 6/pen. By week 10, calves should weigh 180 to 200 lb. Other vaccinations to consider during the conditioning period would be vaccines against pasteurella multicoda and clostridia organisms.

Pre-weaning liquid and starter feed considerations:

Calves should be encouraged to consume dry feed as soon as possible. A quality liquid feeding program is essential. Many calves on dairy farms will be fed discard milk at 8 to 10% of birth weight. The use of quality milk replacers is prevalent for larger groups of purchased calves. Formulations of typical milk replacers are shown in Table 2. Milk protein sources may be replaced (50 to 60%) by non-milk proteins such as soy protein concentrate, modified wheat protein or animal plasma proteins. Evaluate the label carefully to ascertain the quality of the milk replacer. Medicated milk replacers that contain antibiotics such as 200 g oxytetracycline and 400 g neomycin/ton of milk replacer help calf performance. Similarly, incorporation of coccidiostats into milk replacers such as decoquinate has a positive affect on calf health.

Table 2. Formulation of typical calf milk replacers with varying protein sources[a]

Ingredient	All milk protein	Protein isolate, e.g. soy/modified wheat	Protein concentrate, e.g. soy/plasma
	-------------	%	-------------
Whey protein concentrate	44.5	7.0	9.2
De-lactosed whey	10.0	10.0	10.0
Dried whey	25.2	50.8	49.8
Protein isolate	0.0	11.2	0.0
Protein concentrate	0.0	0.0	15.0
Fat	19.0	19.5	14.5
Mineral, vitamin, amino acid pre-mix	1.3	1.5	1.5
Compositional analysis:			
Protein	20.0	20.0	21.0
Fat	20.0	20.0	15.0
Fiber	0.15	0.15	0.5
Lactose	48.0	46.0	47.5
Replacement of milk protein, %	0.0	50.0	48.0

[a] Adapted from Tomkins et al., 1994.

Conventional liquid feeding programs offer 1 lb of milk replacer powder/calf daily reconstituted to 12.5% solids (8 lb of liquid fed/day). According to Tomkins et al. (1994), this level may be inadequate for optimum growth during the first 14 days when starter intake is limited. These authors compared a conventional to a "step-up" program for 4, 5 or 6 week weaning systems (Table 3). The "step-up" program enhanced calf performance and feed efficiencies, especially during the first 14 days.

During winter months in Minnesota, calves housed outside require extra energy for maintenance and sustained growth. Increasing the amount of milk replacer would be advantageous, ensuring that starter feed is available at all times. Chester-Jones and Ziegler (1992) found that calves housed outside required 14.5% more dry matter from milk solids and starter feed to maintain comparable growth to those housed inside. Be aware that use of high fat milk replacers, when starter is readily available, may depress dry starter intake and compromise growth (Tomkins et al. 1994).

Physiological adaptation, rather than learned behavior, to grain diets pre-weaning will enhance dry feed intake post weaning (Luchini et al., 1991). A goal is to establish adequate dry feed intake to allow for earlier weaning and reduce overhead costs. Factors that influence calf feed intake include diet composition and digestibility, rumen pH, acid/base balance, and saliva production. Calf starters should be coarse textured providing 1.3 to 1.5 Mcal ME/lb, 18% CP, at least 8 to 10% fiber, 2000 IU/lb vitamin A, 200 IU/lb vitamin D, 25 IU/lb vitamin E (supplementation with 125 IU/day is beneficial for calves to 24 weeks of age); include .7 to .8% Ca and .45 to .5% P (DM basis). Check the trace minerals specifications carefully in the starter. Minimum requirements listed for beef cattle by NRC (1984) are: Co - .1 ppm; Cu - 8 ppm; I - .5 ppm; Fe - 50 ppm; Mn - 40 ppm; Zn - 30 ppm; and Se - .2 ppm. Supplemental Se may be necessary in Se deficient areas. Many starters will contain coccidiostats such as decoquinate and ionophores to reduce the prevalence of coccidiosis. The prevalence of cryptospiridiosis in young calves throughout Minnesota may be controlled by good sanitation management as no specific efficacy has been established for a feed additive, although claims have been made for some cryptospiridia control with decoquinate and lasalocid. Other feed additives such as yeast cultures, sodium bicarbonate, potassium bicarbonate and potassium chloride have shown positive effects on calf performance.

Table 3. A 'step-up' milk replacer feeding program compared to a conventional regimen fed to calves for 4, 5 or 6 weeks[a]

	Conventional program		'Step-up' program		
Days on milk replacer	Amount of milk replacer powder/day	Total solution fed/day, assuming 12.5% solids	Amount of milk replacer powder fed/day	Total solution fed/day, assuming 12.5% solids	Percent solids if constant quantity of 8 lb/day
	------ lb ------				
1 to 7	1.0	8.0	1.0	8.0	12.5
8 to 10	1.0	8.0	1.13	9.0	14.1
11 to 13	1.0	8.0	1.25	10.0	15.6
14 to 16	1.0	8.0	1.38	11.0	17.2
17 to 19	1.0	8.0	1.5	12.0	18.8
20 to 22	1.0	8.0	1.63	13.0	20.3
23 to 28	1.0	8.0	1.75	14.0	21.9
Total powder, 4 wk weaning	**28.0**		**38.13**		
29 to 30	1.0	8.0	1.5	12.0	18.8
31 to 32	1.0	8.0	1.25	10.0	15.6
33 to 35	1.0	8.0	1.0	8.0	12.5
Total powder, 5 wk weaning	**35.0**		**46.63**		
36 to 42	1.0	8.0	1.0	8.0	12.5
Total powder, 6 wk weaning	**42.0**		**53.63**		

[a] Adapted from Tomkins et al., 1994.

The choice of calf starter should be based on both economics and, the ability to provide a high energy diet (.58 to .60 Mcal/lb NEg) to optimize efficient performance until dry feed intake reaches at least 9 to 10 lb/calf dairy (about 300 lb body wt). Protein sources often constitute the most expensive part of starter diet formulations. Attempts to improve quality of available protein in high energy diets have met with mixed results. Positive calf responses have been shown for use of higher ruminal bypass plant protein sources than SBM during the production phase to 400 lb, such as roasting soybeans @ 295°F (Abdelgadir et al., 1993). No advantages were observed by Miller et al. (1986) for distillers grains and meat meal vs SBM as supplemental N sources in corn based diets with 10% ground alfalfa fed from 94 to 400 lb. Optimal feed intake with high corn-SBM based diets may preclude the necessity to spend extra money on higher protein levels and ruminal bypass protein sources if performance is adequate to 400 lb. Any feed switches should be accomplished in individual housing prior to moving to group pens. An example would be a transition from coarse-textured starter to a whole corn:pellet program. It is pertinent to note that by nature Holsteins are not aggressive and are slow to adapt to large groups (Boomer, 1993). This author suggested calves remain in individual housing for 10 to 14 days after weaning. At 7 weeks of age, calves should be moved to small group pens and to larger pens two weeks later.

Starter production goals:

Production goals from weaning to 400 lb based on research results at the Southern Experiment Station include average dry feed intake of 7.5 lb, average daily gain of 2.5 lb, and feed to gain of 3.0 lb (as fed). The better performances have occurred with either a whole corn diet fed 3:1 with a pelleted protein supplement (28% CP), or a complete coarse mixture of rolled corn, 10% ground alfalfa with SBM, extruded soybeans with or without urea as supplemental N sources.

Use of self-feeders vs daily feeding of total mixed diets:

Many commercial feedlots are successfully utilizing the self-feeding whole corn:pellet program for light and heavy feeder steer production systems. If digestive problems are indicated that may result from inconsistent feed intake, these have been attenuated by providing a palatable bedding source such as corn stalks, limited to 0.25 to 2 lb/steer daily, or free choice long hay. Hay may be ground and mixed (5 to 10%) with the whole corn:pellet as a preferred method of providing roughage rather than a separate bale feeder. Research at the Southern Experiment Station with the whole corn:pellet programs shows that calves perform well without additional roughage if feed is in front of them at all times. Fresh water availability is also critical to help maintain feed intake. Self-feeding Holstein steers requires less time, labor, facilities and equipment than feeding total mixed diets. A 2 to 3 ton capacity double sided 12 ft feeder, for example, has been shown adequate for a pen up to 80 calves. Close daily observation of cattle by walking the lots is important for early detection of health problems.

Alternatively, daily provision of total mixed diets allows for greater control of feed additive intake (ionophores), greater ability to measure group pen intake swings, ability to integrate byproduct and/or higher moisture feeds, ability to utilize roughage more effectively, ability to change diets immediately with drastic weather patterns, and greater ability to notice silk animals. Holstein steers are "station" feeders and prefer liberal bunk space. Optimal space seems to be 6 to 9 inches/head to 300 lb, and 9 to 12 inches from 300 to 600 lb.

Phase 2: Growing Finishing Strategies

Option 1 - Continuous high concentrate feeding:

Healthy, uniform 300 to 400 lb feeder steers are very marketable and still maintain excellent potential for rapid growth and efficient gains on high energy diets. On a continuous 90:10 concentrate to roughage diet, Holstein steers will perform well in the feedlot with peak growth rates between 500 and 700 lb body weight. Feed intake will continue to increase but daily gain and feed efficiencies will gradually decline as projected in Table 4.

Demand also exists for 500 to 700 lb feeder steers that will readily fit into existing commercial facilities designed to feed 500 lb cattle or heavier. Feeding strategies should maintain economic efficiencies for both light and heavy feedlot steers. Schaefer et al. (1986) observed decreased steer growth rate and feed efficiency if amount of the corn silage was increased from 10, 25 to 40% with high moisture corn continuously fed from 431 to 1100 lb market weight. Feed cost of gain would increase with higher corn silage levels. Regardless of feeding strategy, feedlot diets should contain ionophores and the cattle should be implanted to enhance economic efficiencies. The performance response to ionophores and implants are cumulative.

Table 4. Projected feedlot performance of Holstein steers from 200 to 1200 lb when fed a 90:10 concentrate:roughage diet[a]

Live weight	Feed dry matter intake	Feed intake, as fed	Avg daily gain	Avg dry matter/ lb gain
	---------- lb ----------			
200	6.55	7.6	2.25	3.0
300	9.10	10.6	3.00	3.5
400	10.00	11.6	3.50	4.0
500	12.00	13.9	3.50	4.5
600	14.40	16.3	3.25	5.0
700	15.50	17.5	3.25	5.8
800	16.00	18.6	3.00	6.4
900	18.00	20.9	3.00	6.8
1000	20.00	23.3	2.75	7.5
1100	22.00	25.6	2.75	8.5
1200	24.00	27.9	2.25	11.0

[a] Adapted from Boomer, 1993.

Comments on whole corn:pellet programs:

Another example of an accelerated growing-finishing program is the continuous self-feeding of whole corn:pellet with no roughage. **These programs result in excellent feed conversions for long fed Holstein steers if optimal dry matter intake is maintained. Good feedlot management is necessary to maintain consistent feed intakes.** An example of economic projections and performance of Holstein steers fed a whole corn:pellet program from weaning to a market weight of 1227 lb is shown in Table 5. These projections also include pre-weaning costs using a purchase price of $140/head for week-old calves. The effect of varying prices of corn on feed costs is shown. Projections calculated on July 1995 using the current corn price of $2/bushel estimated a net income of $134/steer would be expected for choice Holstein steers based on $61/cwt live weight.

Performance projections by month and changes in feed cost of gain with varying corn prices are shown in Table 6. Feedlot operators purchasing 350 to 400 lb steers can place these steers on a relatively high corn diet immediately, if this was similar to their previous regimen. To ensure a smooth transition upon arrival to maximum intake, a self-feeder should be partially filled with whole corn:pellet mix, and long hay offered for the first two weeks. In addition, palatable bedding such as corn stalks, can be used. Steers can be on full-feed within 10 days. Newly received feeder steers to be daily fed a 90:10 concentrate diet in a bunk can be placed on a diet of 80% corn and supplement and 20% forage. The forage should be similar to that which was used in the diet used prior to arrival.

Table 5. High energy, no roughage feeding program for Holstein steers - example of economic projections from 100 lb to 1227 lb market weight[a]

	Whole corn price, $/bushel		
Item	2.00	2.25	2.50
Steer Performance			
Initial weight, lb	100	100	100
Final weight, lb	1227	1227	1227
Daily gain, lb	2.9	2.9	2.9
Feed/gain, lb	5.5	5.5	5.5
Days on feed	395	395	395
VARIABLE COSTS ($)			
Milk replacer, 25 lb @ $1730/ton	21.19	21.19	21.19
Calf starter, 50 lb @ $324/ton	8.10	8.10	8.10
Grower pellet, 181 lb @ $372/ton	33.67	33.67	33.67
Finisher pellet, 479 lb @ $330/ton	90.97	90.97	90.97
Whole corn, 87 bushels	194.83	216.47	238.12
TOTAL FEED COSTS ($)	**348.76**	**370.40**	**392.05**
Other Costs ($)			
Calf purchase cost, 100 lb	120.00	120.00	120.00
Vet & medical expenses	15.00	15.00	15.00
Cull & death loss (5%)	16.08	16.26	16.43
Yardage, $0.20/steer daily	79.04	79.04	79.04
Interest @ 10%	32.17	32.51	32.85
TOTAL EXPENSES, $	**611.05**	**633.21**	**655.37**
Feed cost of gain, $/lb gain	0.31	0.33	0.35
Gross income @ $60/cwt live wt	736.20	736.20	736.20
NET INCOME, $	**125.15**	**102.99**	**80.83**
Break-even, $/cwt live wt	0.50	0.52	0.53

[a] Projections calculated July 1995, based on research with a whole corn:pellet, no roughage program conducted by Domain, Inc. and the University of Minnesota Southern Experiment Station.

Table 6. Performance projections of Holstein steers by monthly body weight changes when fed a high energy, no roughage program[a]

Days on feed	Starting weight	Ending weight	Daily gain	Feed/lb gain, as fed	Cost of gain, $/lb at corn prices/bushel $2.25	$2.50	$2.75
	------------	lb	------------				
0 to 30	100	130	1.0	2.5	0.98	0.98	0.98
61	130	189	1.9	2.7	0.22	0.23	0.24
91	189	264	2.5	3.0	0.24	0.25	0.26
122	264	346[b]	2.7	3.8	0.29	0.30	0.31
152	346	441	3.1	3.8	0.24	0.25	0.25
182	441	542	3.3	4.2	0.25	0.27	0.28
213	541	654	3.7	4.4	0.25	0.26	0.28
243	654	766	3.7	4.8	0.26	0.28	0.30
274	766	872	3.5	5.2	0.29	0.31	0.33
304	872	975	3.4	5.6	0.30	0.33	0.35
334	975	1070	3.1	6.4	0.34	0.37	0.39
365	1070	1154	2.8	7.2	0.39	0.42	0.44
395	1154	1227	2.4	8.8	0.46	0.50	0.53
426	1227	1297	2.3	9.1	0.48	0.52	0.56
456	1297	1364	2.2	9.5	0.50	0.54	0.58
486	1364	1428	2.1	10.0	0.53	0.57	0.61

[a] Calculated July 1995, based on research with a whole corn:pellet, no roughage program conducted by Domain, Inc. and the University of Minnesota Southern Experiment Station.

[b] Rumensin (180 mg/steer daily) and Tylan (90 mg/steer daily) included in the pellet for the remainder of the feeding period.

Concern has been expressed by commercial operators that continuous feeding of high concentrate diets throughout the growing-finishing periods (especially through a self-feeder) results in a "stall-out period" that causes inconsistent dry matter intakes. Schaefer et al. (1989) observed that long periods of concentrate feeding (from 250 lb to finished market weight) may increase frequency of ulceration of rumen papillae which might result in increased liver abscesses. Problems with fluctuating intakes may be offset by offering a palatable roughage especially where cattle are self-fed whole corn:pellet programs.

Recent work by Chester-Jones et al. (1993) suggests the maximum intake of 2 lb/day long hay by Holstein steers fed a whole corn:pellet program. In that study, Holstein steers were offered free choice or limit fed (3/4 lb/day) medium quality hay with whole corn and 3-lb pellets/steer (30.4% CP, 15.7% ADF) daily. The feed to gain tended to increase with higher hay levels but overall feedlot gain was not affected by the amount of hay consumed. All steers were marketed on the same day, and those fed whole corn:pellet without access to hay had higher carcass quality grades. Traxler et al. (1993) investigated the influence of dietary fiber on the performance of Holstein calves fed high concentrate diets from 350 to approximately 1200 lb market weight. Diets included: continuous whole corn:pellet (WCP); WCP in growing period and cracked shelled corn (CSC) with built-in roughage (BIR - 7% of diet DM) during the finishing period; BIR (15% of diet DM) and CSC in the growing period, and WCP in the finishing period; continuous BIR and CSC at 90:10; WCS with 10% haylage; and CSC and haylage at 90:10. The study showed that steers fed the continuous WCP had the highest net return and those fed the continuous BIR the lowest net return. An evaluation of rumens at slaughter indicated no dietary treatment effect; although, the rumen appeared to have deteriorated in health with the longer feeding period across all diets.

Option 2 - Feeding different forage:concentrate ratios - Two-phase feeding program:

After 20 years of comprehensive studies with Holstein steers at the Southern Experiment Station, Miller et al. (1983) recommended a two-phase growing-finishing program from 400 lb to market weight. These authors noted compensatory gains for steers fed high forage growing rations to 750 lb, if followed by high energy finishing rations. Satisfactory performance was attained with a 75% alfalfa hay, 25% corn grain and supplement growing ration, followed by a 7 to 10% alfalfa hay, and 90 to 93% concentrate finishing ration. Even better performances were attained with 3 to 4 parts corn silage to 1 part corn and supplement (as-fed basis) fed up to 700 to 800 lb in the growing phase, followed by a finishing ration of equal parts of corn silage and corn grain. In all of these studies, urea was the main supplemental nitrogen source.

More recently, Siemens (1994) suggested that higher roughage growing rations help control the delay in the physiological maturity of the Holstein steer which is often caused by continuous feeding of high energy diets. In addition, he observed that higher roughage diets may also control the propensity for sub-acute acidosis associated with high concentrate diets. This author fed different haylage levels (10, 30, 50 or 70%) with whole high-moisture corn to Holstein steers from 380 to 675 lb. Haylage of high (21% CP) or lower (15% CP) quality were compared. After 675 lb, all steers were fed a 90% whole high-moisture corn:10% haylage ration. In all diets a supplement based on SBM and mineral with Rumensin/Tylan was offered. Conclusions were that high-energy feed, fed to 300 to 350 lb Holstein calves, can be switched to a 50:50 haylage:concentrate growing ration and show gains >2.5 lb/day with a 5:1 feed conversion. In addition, the potential for reduction of feed costs can be attained, and the control of sub-acute acidosis is sustained by feeding up to 30% forage during the growing phase. The quality of the haylage did not affect performance, except at the 70% inclusion rate.

In a Cornell study reported by Fox and Ketchen (1991), purchased Holstein calves were fed a 40% concentrate diet to 20 weeks of age (340 lb), then switched to 10, 30 or 50% alfalfa silage (17% CP) diets with whole corn, SBM and Monensin supplement. Diets were fed to light (310 lb) and heavy (378 lb) calves for 98 days, then were switched to a 90:10 corn:alfalfa haylage diet. Half of the steers were implanted with Ralgro and re-implanted with Revalor after 98 days. The results of the study are summarized in Table 7. There were no differences between feeding systems in overall daily gain. The response to Revalor was 18% in daily gain and 12% increase in feed efficiency. The implant did not influence the weight at which the steers reached choice marbling score. In a second study, two groups of Holstein steers were fed 50 or 10% haylage with whole corn and a third group was rotationally grazed for 175 days before switching to the 90:10 finishing ration. Steers fed high haylage diets or grazing pastures in the growing period showed excellent compensatory growth in the finishing period.

The study demonstrated that pasture could be utilized for the length of the grazing season with no effect on weight at choice grade or carcass cutability. Pasture grazing increased the number of days steers reached slaughter weight by 48. Ainslie et al. (1992) evaluated the economic efficiency of the Cornell study. They concluded that steers on pasture grew 11% more efficiently than those fed 50% haylage and 17% more efficiently than those fed 10% haylage when on the 90:10 finishing diet. When haylage is priced at $29/ton, it becomes economical to feed haylage levels >10% with whole corn.

Table 7. Performance of Holstein steers fed 90% concentrate starter and finishing diets with different alfalfa silage levels in the grower period, with or without implants[ab]

	Alfalfa silage %, DM basis			Implant	
Item	50	30	10	Yes[c]	No
	------------ grower period ------------				
Initial wt, lb	345	343	340	342	342
Days on feed	98	98	98	98	98
Final wt, lb	592	614	639	626	603
Daily gain, lb	2.52	2.77	30.05	2.90	2.66
Feed DM/lb gain	5.09	4.72	4.45	4.6	4.95
	------------ finishing period ------------				
Final wt, lb[d]	1143	1134	1155	1126	1162
Daily gain, lb	2.89	2.95	2.62	3.05	2.58
Feed DM/lb gain	6.83	6.47	7.77	6.40	7.24
	------------ grower and finishing periods ------------				
Daily gain, lb	2.75	2.79	2.80	2.98	2.57
Feed DM/lb gain	6.22	5.87	6.02	5.70	6.37

[a] Adapted from Fox and Ketchum, 1991.

[b] Steers fed 90% corn concentrate diets to 20 wk of age; switched to alfalfa silage (17% CP) diets with whole corn, SBM, and Rumensin supplements for 98 days (implanted with Ralgro at the switch); fed 90% concentrate and 10% alfalfa silage finishing diet (implanted with Revalor after the grower period.

[c] Implant effect in each period for all parameters.

[d] Adjusted to a common dressing percentage (60.4); overall avg of 78% choice.

Energy and protein sources for growing-finishing programs:

A standard Minnesota feedlot diet consists of 80% corn (DM basis) and 20% corn silage with 1 lb protein-vitamin-mineral supplement that contains an ionophore and perhaps a sub-therapeutic antibiotic (Anderson and Chester-Jones, 1991). Research from Nebraska suggests that mixing slowly and rapidly ruminally degradable energy sources can enhance feed intake and feed efficiency and reduce the potential for sub-acute acidosis. The ideal mix has been suggested to be 2/3 rapidly degradable energy sources (ground corn, processed wheat, milo or barley, or cracked/rolled high moisture corn) and 1/3 slowly degradable sources (whole high moisture corn or whole or minimally processed dry corn). Anderson and Chester-Jones (1991) suggested 2/3 high moisture corn and 1/3 dry corn plus 20% corn silage is a good ration. Fox and Ketchen (1991) observed that high moisture corn gave excellent gains from 200 to 600 lb but dry corn gave better gains from 600 lb to market weight when fed to Holstein steers. They suggested only 1/3 high moisture corn in the final ration of long fed Holstein steers to reduce sub-clinical acidosis.

The use of supplemental protein sources is often based on economics vs growth benefit ratios. Urea fed with or without SBM is an economical protein source for growing and finishing diets. Growing diets may provide 12 to 14% CP and finishing diets 11 to 12% CP. The use of higher ruminal bypass diets do not appear to provide an adequate cost:benefit ratio for their inclusion although performance may be acceptable. However, a response to supplemental rumen protected lysine and methionine was indicated in Holstein steers fed from 350 to 700 lb by Van Amburgh et al. (1993). Trenkle (1993) found that a corn based ration with urea to 11% CP was adequate for non-implanted 700 lb steers to support 3.3 lb gain/day. Implanted steers with higher gain potential needed 14% CP in the diet (supplied by 10% SBM) to attain a growth potential of over 4 lb/day. Supplying non-implanted steers with higher ruminal potential protein diet did not enhance growth. In the diets fed to fast gaining implanted steers, SBM was superior to a mixture of ruminal bypass protein sources. More research is needed to refine these feeding strategies.

Byproduct feeds can offer potential energy sources for growing-finishing steers. Knowledge of opportunity, prices, maximum dietary limit, and compositional analysis are critical prior to incorporating into diets. In Minnesota, bakery waste, beet pulp, wet and dry brewers grains, wet and dry corn gluten feed, distillers grains, soy hulls and sweet corn silage waste are examples of available byproducts that can be well utilized in growing-finishing diets.

Implant considerations for Holstein steers:

Pritchard (1993) outlined implant strategies for beef cattle suggesting that their use should be in a sequence of increasing potency. He also noted that after the initial implant, gain response to subsequent implants is diminished. Examples of implant strategies were given as follows (these strategies can be considered for various Holstein steer production systems):

- 200-day feeding period - An initial Implus and a terminal implant after 100 days. If feeding for 180 days, start with Synovex.
- 120-day growing / 120-day finishing - An initial implant (e.g., Ralgro or Synovex C); re-implant after 60 days with Synovex or Implus; third implant 90 days later -- terminal implant (Synovex + Finaplix; Implus + Finaplix; or Revalor) -- 80 to 90 days from slaughter; could use one Compudose initially and a terminal implant after 150 days.
- Feeding periods 100 to 150 days - Many options: e.g., Ralgro or Implus and a terminal implant 80 days prior to slaughter; Compudose then Finaplix halfway through feeding period to obtain some overlap benefit of a combination terminal implant towards the end of the feeding period.
- 60 to 80-day cattle with unknown history - Do not use a terminal implant; Ralgro is a best selection for high quality carcass; Implus and Synovex may lower feed cost to gain but also could reduce marbling scores.
- Holsteins to be marketed as light feeder steers can be implanted at weaning with single (Compudose) or double (Ralgro, Implus or Synovex); longer fed Holsteins can be implanted post-weaning at 200 lb and another two times prior to market. Four hundred to 500 feeder Holstein steers should be implanted twice prior to market weight. Multiple implants prior to 600 lb may not be necessary to optimize feedlot growth. Recent Southern Experiment Station Holstein steer research indicated a 19% response in growth rate by steers implanted just once at 600 lb (Compudose) and marketed at 1250 lb. Steers were fed a whole corn:pellet program.

Conclusion

Feeding strategies for Holstein steers can be designed to fit the varying ages and weights of the cattle to optimize economic returns. Whole corn:pellet programs work well if managed efficiently. Advantages can be taken of compensating growth potential for feeding high energy diets after a period of higher roughage feeding. An analogous response is often observed in large frame "green" steers taken off pasture/range then fed high energy feedlot diets. A market weight goal for a specific niche must be attained to maintain profitability of a production system. This was exemplified by work in Minnesota when purchased 600-lb Holstein steers were fed 78% high moisture corn:17.5% corn silage (DM basis) plus 1 lb protein supplement to 1000, 1100, 1250 or 1350 lb market weight. Steers fed to 1250 lb were the most economical under the conditions imposed. It is important to define clear marketing objectives and production goals for Holstein steers prior to establishing a system that fits specific feed, labor and facilities available.

Literature Cited

Ainslie, S.J., D.G. Fox and W.A. Knoblaugh. 1992. Predicting the profitability of alfalfa silage and pasture feeding systems for Holstein steers. J. Anim. Sci. 70:2652.

Abdelgadir, I.E.O., J.L. Morrill and A.M. Feyerham. 1993. Effect of roasting soybeans and corn on dairy calf performance. J. Dairy Sci. 76 (Suppl. 1):273.

Anderson, P.T. and H. Chester-Jones. 1991. Suggestions for feeding Holstein steers in Minnesota. Beef Cattle Management Update Issue 23, October 1991. Minnesota Extension Service, Univ. of Minnesota, St. Paul.

Boomer, W.G. 1993. Protocol for profitable Holstein beef production. Proc. Fall Vet. Conf. pp. 1-14. Univ. of Minnesota, College of Vet. Med. and Minnesota Extension Service.

Chester-Jones, H. and D.M. Ziegler. 1992. Effect of winter housing type on performance of dairy calves from birth to seven weeks of age. Southern Exp. Sta. Rpt. pp. 129-131.

Chester-Jones, H., D.M. Ziegler, G.L. Dobberstein and P.T. Anderson. 1993. Feedlot performance and carcass quality of spring finished Holstein steers fed whole corn and pelleted supplement with or without access to long hay. Minnesota Beef Res. Rpt. B-401. pp. 42-47. Univ. of Minnesota, St. Paul.

Fox, D.G. and D.T. Ketchen. 1991. Feeding Holstein steers: A summary of 10 years of research. Proc. Holstein Beef Production Symp., Northeast regional Agric. Eng. Service, Ithaca, New York. pp. 71-81.

Luchini, N.D., S.F. Lane and D.K. Combs. 1991. Dry matter intake and metabolic responses of calves weaned at 26 days of age. J. Dairy Sci. 74 (Suppl. 1):187.

Miller, K.P., R.D. Goodrich, J.C. Meiske and S.D. Plegge. 1983. Feeding Holstein steers for beef. Minnesota Beef Res. Rpt. B-312. pp. 46-54. Univ. of Minnesota, St. Paul.

National Research Council. 1984. Nutrient requirements of beef cattle. 6th Rev. Ed. Natl. Acad. Sci., Washington DC.

National Research Council. 1989. Nutrient requirements of dairy cattle. 6th Rev. Ed. Natl. Acad. Sci., Washington DC.

Pritchard, R.H. 1993. Strategies for implanting feedlot cattle. Minnesota Beef Res. Rpt. B-407. pp. 82-87. Univ. of Minnesota, St. Paul.

Schaefer, D.M., D.R. Buege, D.K. Cook, S.C. Arp and B.Z. Renk. 1986. Concentrate to forage ratios for Holstein steers and effects of carcass quality grade on taste panel evaluation. J. Anim. Sci. 63 (Suppl. 1):432.

Schaefer, D.M., K. Scheller, S.C. Arp, D.R. Buege, S.F.Lane, S. Williams and R. Arnold. 1989. slaughter weights and dietary vitamin E supplementation for enhanced viability of finished Holstein steer production systems. Proc. Arlington Cattle Feeeders Day. Univ. of Wisconsin Extension. pp. 29-36.

Siemens, M.G. 1994. Alfalfa in Holstein beef growing rations. Minnesota Forage Update Vol. XIX No. 5. Minnesota Forage and Grassland Council. pp. 4-5.

Tomkins, T., J. Sowinski and J. K. Drackley. 1994. New developments in milk replacers for pre-ruminants. *In*: Proc. 55th Minnesota Nutr. Conf. pp. 71-89. Univ. of Minnesota, St. Paul.

Traxler, M.J., D.G. Fox, T.C. Perry, R.L. Dickerson and D.L. Williams. 1993. Influence of roughage source and timing on feedlot performance of high-concentrate, long-fed Holstein steers. J. Anim. Sci. 71 (Suppl. 1):258.

Trenkle, S. 1993. Protein feeding strategies for lean gain. *In*: Proc 54th Minnesota Nutr. Conf. pp. 127-136. Univ. of Minnesota, St. Paul.

Van Amburgh, M., T. Perry and D. Fox. 1993. Growth response of Holstein steers supplemented with rumen protected lysine and methionine. J. Anim. Sci. 71 (Suppl. 1):260.