Cooperative Extension Service
College of Tropical Agriculture and Human Resources
University of Hawai'i at Mānoa

Livestock Management
Apr. 2008
LM-19

Utilizing Wheat Mill Run for Dairy Calf and Heifer Feed

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Abstract

Hawaiian Flour Mill Inc. (HFM) imports wheat from the Pacific Northwest to be milled into flour in Honolulu. With the decreasing number of milk cows, the wheat millings, a powdery feed item, had become an economic headache and an environmental problem for the company. The objectives of this research were to (1) develop a way to feed this dusty feed to calves and heifers, (2) evaluate the growth rate of the animals, and (3) evaluate the economics of feeding this feed.

Three experiments were conducted: (1) calves at a commercial dairy (C-CD), (2) calves leased from commercial dairies and raised at the UH Waiale'e Livetock Expriment Station (C-UH), and (3) 14-month-old heifers at Waiale'e (H-UH).

C-CD calves were fed millings (treatment) mixed with the milk, while control calves were fed milk and a commercial grain mix ad libitum. C-UH calves were fed millings in milk at 4 weeks of age and millings plus alfalfa cubes after weaning. H-UH heifers were fed either 2.27 kg of wheat millings mixed with 1 gallon water or 2.27 kg of steam-flaked barley daily, and free-choice pasture. In the C-CD group, the average daily gain (ADG) was 0.21 kg for the treatment and 0.66 kg for the control prior to weaning. The C-UH calves grew at 0.18 kg/day prior to weaning and 0.69 kg/day after weaning. Holstein and Jersey crosses grew at different rates. The H-UH group fed wheat milling grew faster than the control; 1.52 kg/day vs. 1.26 kg/day. The economics showed that wheat millings could be used in calf and heifer rations, thus reducing the environmental impact on landfill and presenting farmers with an alternative feed choice.

Introduction

Hawaiian Flour Mill Inc., located on North Nimitz Highway, imports wheat from the Pacific Northwest to be milled in Hawai'i. Wheat millings disposal is becoming a problem for the mill for the following reasons:

- The number of dairy cows on the island has drastically decreased, from more than 7000 to less than 3400.
- Shipping the wheat millings to the mainland is not feasible because of the very high cost.
- Dumping of these wheat millings in the landfill has been prohibited (Waimānalo Gulch is at capacity).
- Wheat millings could be used in making compost, and some is used by Hawaii Earth Products. This is costly to HFM due to a "dumping" fee.
- The dusty, powdery nature of the wheat millings limits its intake in animals and may cause respiratory problems.

Wheat mill run (WMR)

The term "wheat mill run," also called "wheat midds" or "middlings," refers to the leftover materials remaining after flour, or semolina, is extracted from wheat or durum during milling. WMR generally includes ground screenings from cleaning; remnant particles of bran, germ, and flour; and other offal from the milling process. WMR contains higher levels of fiber, protein, and minerals than the parent grain, with reduced amounts of starch and energy.

WMR contains 17 percent crude protein and 75 percent total digestible nutrients on a dry-matter basis[6]. WMR has been incorporated into adult ruminant rations for many years. Various trials at North Dakota State University's

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Carrington Research Extension Center indicated that cows perform to their genetic potential when fed rations primarily containing WMR and straw if the ration is balanced for the animal's dietary requirement[8].

Calf requirements

The metabolizable energy requirement for calves based on National Research Council recommendations is 1.69–3.5 Mcal per day based on their body weight and growth rate. Calves require about 16–20 percent crude protein in the total ration[7].

Newborn and young calves being fed primarily liquid diets have only one functional stomach. The abomasums is the only stomach that is fully developed and functional. When a calf is fed milk or milk replacer, the closure of the esophageal groove allows the milk to bypass the reticulo-rumen and flow directly into the abomasums[4]. However, when solid feeds are ingested, the esophageal groove gradually ceases to function, a population of bacteria is established in the rumen, and rumen wall development begins. Eventually, heifers become capable of utilizing fibrous feed because of the microbes living and growing in their rumen. We can assume that the rumen has become functional when a young heifer begins to chew her cud at 2–4 months of age. Thus the availability and early ingestion of solid food allows rapid rumen development and early weaning[5].

What was done (materials and methods)

Three experiments were conducted with 16 Holstein calves, 14 Jersey-Holstein cross calves, and 12 Holstein heifers.

First experiment: Calves at a commercial dairy (C-CD)

We compared preweaning growth rates of dairy calves fed WMR (the treatment) and conventional grain (the control). The experiment was conducted at a commercial dairy. Holstein (12) and Jersey-Holstein cross (7) calves 16 days old were selected. Before the experiment, they were fed a commercial grain mix. The treatment group, consisting of seven Holstein and three Jersey-Holstein cross calves, was fed 90 grams of WMR mixed with milk replacer once each day for 26 days. The WMR milk replacer mixture was available to the treatment group only for a short period. The control group, consisting of five Holstein and four Jersey-Holstein cross calves, was fed milk replacer twice each day, and calf grain mix was available throughout the day. Provision of rations containing milk replacer had to be worked into the daily routine of the commercial operation. The containers could not be left out for long, because they attracted flies.

The weekly weight gain was measured using the Coburn calf-weighing tape purchased from The Coburn Company, Inc., Wisconsin, USA. The animal was made to stand with her head upright, and the tape was snugly placed around the heart girth just behind the front legs and shoulder blades. The tape reading provides the weight in pounds.

Second experiment: Calves at UH (C-UH)

This experiment compared the growth of preweaning and post-weaning calves fed WMR in milk replacer with the normal average growth rate of calves reported in the literature. It was conducted with calves leased from commercial dairies and brought to the UH Waiale‘e Livestock Experiment Station at 1–4 days of age. During the preweaning period, Holstein (4) and Jersey-Holstein cross (7) calves were fed 300 g WMR mixed with milk replacer for 41 days. Their weekly body weights were measured using the weighing tape. The animals were weaned off milk at 65 days of age.

In the second phase, during post-weaning, the calves were fed daily with 1.2 kg of WMR and 0.65 kg of alfalfa cubes and allowed to graze in pastures for 35 days. Their weekly weight gains were measured. Any changes in their health status or management throughout the period were recorded.

Third experiment: Heifers at UH (H-UH)

This experiment compared the growth rate of heifers fed WMR with conventional rolled barley in the ration. In this experiment, 12 Holstein heifers 14 months old were selected and assigned into two groups, treatment and control. The treatment group was fed 2.74 kg of WMR mixed with 1 gallon of water per head. The control group was fed 2.74 kg of conventional rolled barley per head. The study period was 33 days. Weight gains were measured by tape weekly.

Results

In the first experiment, at the commercial dairy, the average daily gain (ADG) of the control group was 0.66 kg/day, while that of the treatment group was 0.21 kg/day. For the Holsteins in the treatment group, the ADG was 0.25 kg, while the control group Holstein ADG was 0.77

kg. For the Jersey-Holstein cross calves in the treatment, ADG was 0.10 kg, while for those in the control group it was 0.52 kg (Table 1).

In the experiment with calves at the Waiale‘e, the pre-weaning ADG was 0.18 kg/day, while the post-weaning ADG was 0.69 kg/day. The pre-weaning ADG for the Holstein breed was 0.22 kg, while for the Jersey-Holstein breed it was 0.16 kg (Table 2). The post-weaning ADG for the Holstein breed was 0.85 kg, and for the Jersey-Holstein breed it was 0.61 kg. Although the pre-weaning ADGs were less than those mentioned in the literature, the post-weaning ADGs were within the normal range for ADG[2,3].

In the heifer experiment, the ADG attained by the control group was 1.26 kg/day, while for the treatment group it was 1.53 kg/day. The ADG achieved by the heifers in the treatment group was not only higher than the control ADG but also higher than the normal ADG for the Holstein breed of the cattle (Table 4).

Discussion

In the experiment at the commercial dairy, the ADG achieved in treatment calves was 0.21 kg/day, vs. 0.66 kg/day for the control calves. The expected ADG is 0.32–0.64 kg/day[1,2]. The lower performance for this experiment may be due to the ill health of the calves in the treatment group, in which some calves had diarrhea at the very start of the experiment. In addition, the wheat millings in the milk were available to treatment group only for a limited period, while for the control group, the grain mix was available throughout the day. This management decision was necessary to reduce breeding of flies in the WMR-milk mixture. The cost of the ration per animal per day for the treatment group was $1.92, vs. $2.01 for the control group.

In the experiment with calves at Waiale‘e, the preweaning ADGs of Holsteins and Jersey-Holstein crosses were 0.22 and 0.16 kg/day, respectively. These ADGs were less than the average range of ADG for both the breeds. The low growth rates could be due to lack of colostrums in the early start of life. Colostrum is rich in antibodies and is the major source for immune defense for calves. Low growth rate due to lack of colostrums was suspected based on the postmortem findings of one of the calves, which indicated immunosuppression, probably due to inadequate passive transfer. In addition, the transportation of the newborn calves over 40 miles to the station could have added additional stress. However, the post-weaning

Table 1. Calves at commercial dairies (C-CD) receiving either treatment (Trt.) or concentrate (Con.).

	All		Holstein		Jersey-Holstein	
	Trt.	Con.	Trt.	Con.	Trt.	Con.
n	10	9	7	5	3	4
ADG	0.21	0.66	0.25	0.77	0.10	0.52
SE	0.03	0.11	0.03	0.10	0.04	0.21
Theoretical range[1, 2]			0.32–0.64		0.17–0.36	

Table 2. Second experiment, preweaning calves at UH (C-UH).

	All	Holstein	Jersey-Holstein
n	11	4	7
ADG	0.18	0.22	0.16
SE	0.02	0.03	0.02
Theoretical range[1, 2]		0.32–0.64	0.17–0.36

Table 3. Second experiment, post-weaning calves at UH (C-UH).

	All	Holstein	Jersey-Holstein cross
n	11	4	7
ADG	0.69	0.85	0.61
SE	0.07	0.15	0.03
Theoretical range[1,2,3]		0.85–1.25	0.62–1.19

Table 4. Third experiment, heifers at UH Waialee Farm (H-UH).

Animal group	n	ADG kg/day	SE	Theoretical range[2,3]
WMR (treatment)	6	1.52	0.187	0.85–1.25
Barley (control)	6	1.26	0.082	0.85–1.25

Figure 1. Performance of C-CD calves feed wheat millings or commercial calf starter concentrate.

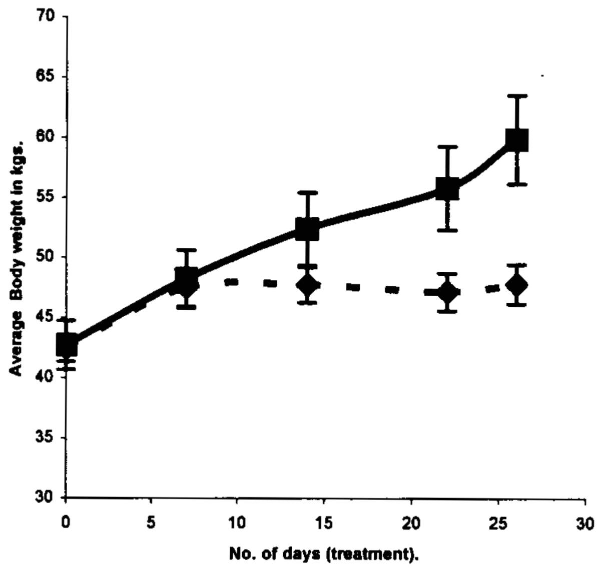
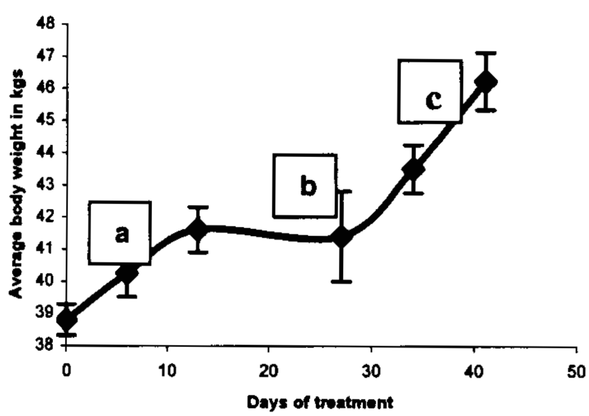
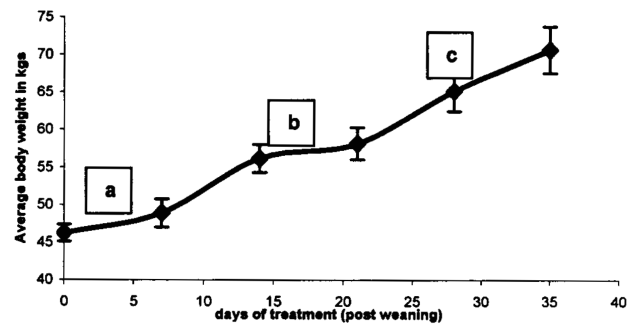


Figure 2. Performance of C-UH preweaning calves fed wheat millings and milk replacer.



a - Slow growth rate at the initial phase was probably due to either insufficient colostrum or stress due to transportation.
b - Herd man was suddenly hospitalized; substitute help did not fully know the protocol.
c - Growth rate is normal.

Figure 3. Performance of C-UH post-weaning calves fed with wheat millings and alfalfa cubes.



a - Adjustment phase.
b - They were left to the pasture.
c - High growth rate.

Figure 4. Performance of H-UH heifers on pasture fed with wheat millings (n=6) or barley (n=6)

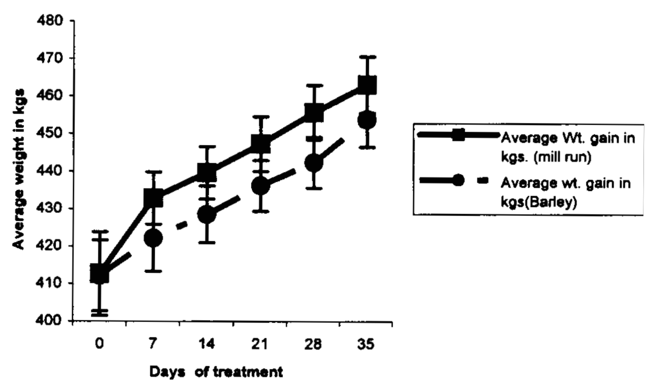


Table 5. Cost of feed ingredients.

Ingredient	Cost, $/kg
Milk replacer	1.67
Wheat millings	0.12
Alfalfa curbes	0.28
Calf grain mix	0.35
Rolled barley	0.31

Table 6. Economics of the feed cost.

Expt.	Group	$/day/ animal	ADG kg/day	$/kg gain
C-CD	Treatment	1.92	0.21	9.14
	Control	2.01	0.66	3.05
C-UH	Preweaning	1.95	0.18	10.83
	Post-weaning	0.36	0.69	0.52
H-UH	Treatment	0.27	1.52	0.17
	Control	0.70	1.26	0.55

ADG of Holsteins (0.85 kg) and Holstein-Jersey crosses (0.61 kg) were within the range of normal ADG[2,3]. This suggests that after the adjustment phase, the calves grew at respectable rates post-weaning.

In the experiment with the yearling heifers, ADG achieved by the treatment was 1.52 kg, which was greater than the ADG of the control group fed the conventional rolled barley, 1.26 kg. This was also greater than ADG (0.85–1.25 kg) reported in the literature[2,3]. The cost of the ration for the treatment per animal per day was $0.27, versus $0.70 for the control, suggesting that desired growth rates can be economically achieved in heifers using wheat millings in the ration (Table 6).

Conclusion

The ADGs achieved in the three experiments were adequate when the animals were healthy and managed properly. Higher growth rates of the yearling heifers on WMR could be compensatory growth following the post-weaning period. This was also observed with the calves at post-weaning in the second phase of the experiment. All the gains were achieved at a cheaper cost to the farmers.

Note: Care should be taken to avoid using WMR infested with the fungus *Claviceps purpurea*, as it may cause ergot in cattle. Cattle fed with WMR should contain adequate levels of calcium in their ration to have the appropriate calcium-to-phosphorus ratio[9,10].

Acknowledgement

The authors wished to thank the staff at Mountain View Dairy, Pacific Dairy, and the UH Waiale‘e Livestock Research Station for their assistance. This research was funded by the Hawaii Farm Bureau Federation and the Hawai‘i Department of Agriculture, 2006–07.

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