Ionophore taste preferences of dairy heifers

P. S. Erickson, M. L. Davis, C. S. Murdock, K. E. Pastir, M. R. Murphy, C. G. Schwab and J. I. Marden

J Anim Sci 2004. 82:3314-3320.

Ionophore taste preferences of dairy heifers[1]

P. S. Erickson*[2], M. L. Davis*, C. S. Murdock*, K. E. Pastir*, M. R. Murphy†[3], C. G. Schwab*, and J. I. Marden§[4]

*Department of Animal and Nutritional Sciences, Ritzman Animal Nutrition Laboratory, University of New Hampshire, Durham 03824; and Departments of †Animal Sciences and §Statistics, University of Illinois, Urbana 61081

ABSTRACT: Two taste preference studies were conducted using six Holstein heifers in each experiment to determine preferences for no ionophore, lasalocid, or monensin in the diet. In Exp. 1, individually penned (approx. 5 mo old; 220 ± 14 kg BW) heifers were fed a basal total mixed ration containing 46% corn silage, 46% grass haylage, and 8% soybean meal (DM basis). There were five treatments (mg/kg $BW^{-1}\cdot d^{-1}$): 0 ionophore (control), 1 lasalocid (1L), 2 lasalocid (2L), 1 monensin (1M), or 2 monensin (2M). Ionophores were provided as part of the mineral mix that had been added to the control diet and through an ionophore-grain by-product mix to make the 2L and 2M treatments. All five diets were offered for 7 d, with the first 2 d for adaptation and the last 5 d for measurement of feed intake. The most preferred diet was then removed and the study continued with the four remaining diets. The most preferred diets were again eliminated sequentially, so that only two diets remained on d 13 and 14. Each feeding segment ranking of treatment preferences was determined based on the weight of feed refused at the end of each feeding segment. In Exp. 2, six 6-wk-old heifers (75 ± 5 kg of BW) were individually fed either 0, 1L, or 1M in a study similar to Exp. 1, except that the most preferred diet was removed after 4 d, with the first day for adaptation and the last 3 d for measurement of feed intake. In Exp. 1, orthogonal contrasts indicated that heifers preferred the 1L and 2L diets over the 1M and 2M diets. Preferences between diet concentrations of ionophores (1 and 2 mg/kg of BW; Exp. 1) and the control and ionophore treatments did not differ, nor was there an interaction between ionophores and their concentration. Dairy heifers previously fed lasalocid prefer lasalocid over monensin when given a choice; however, heifers without previous exposure to an ionophore did not indicate a preference (Exp. 2).

Key Words: Dairy Heifers, Ionophores, Lasalocid, Monensin, Taste

 J. Anim. Sci. 2004. 82:3314–3320

Introduction

Ionophores have been routinely fed to young dairy and beef cattle since receiving U.S. FDA approval in the 1970s. They typically control coccidiosis and alter ruminal fermentation, making the animal more efficient. Because of decreased DMI observed with beef cattle, the NRC (1996) makes negative adjustments for estimated DMI by cattle fed monensin. However, because of variable DMI responses (Baile et al., 1982; Steen et al., 1992), the NRC (2001) does not adjust estimates of DMI for dairy cattle fed ionophores.

The objective of these studies was to determine whether dairy heifers prefer to eat a diet containing no ionophore, lasalocid (Bovatec; Alpharma, Fort Lee, NJ), or monensin (Rumensin; Elanco Animal Health, Greenfield, IN) when given a choice. Cattle producers often observe decreased intakes when cattle are fed ionophores compared with nonmedicated feeds. Our objective was to determine whether the response was due to palatability. Sequential elimination trials similar to that described by Nombekela et al. (1994) were conducted to compare taste preferences among no ionophore, lasalocid, or monensin added to diets fed to dairy heifers. The procedure (Nombekela et al., 1994) allows ranking of preference by intake over a period of time.

[1]This is Scientific Contribution No. 2105 from the New Hampshire Agric. Exp. Stn. Support for this project was through the New Hampshire Agric. Exp. Stn. (H-395), the Hubbard Foundation, and a gift from Hoffmann-LaRoche, Inc. The authors thank the staff of the Univ. of New Hampshire Dairy Teaching and Research Center for care of the animals and C. Dietterle for typing the manuscript.

[2]Correspondence—phone: 603-862-1909; fax: 603-862-0308; e-mail: peter.erickson@unh.edu.

[3]262 Animal Sciences Laboratory.

[4]101 Illini Hall.

Received December 18, 2003.

Accepted July 16, 2004.

Table 1. Chemical composition of mineral mixtures in Exp. 1 (DM basis)

Item	Treatment		
	Control mineral[a]	Mineral plus lasalocid[b]	Mineral plus monensin[c]
Ca, %	11.57	11.57	11.57
P, %	5.38	5.38	5.38
Na, %	10.39	10.39	10.39
Cl. %	16.24	16.24	16.24
K, %	1.75	1.75	1.75
Mg, %	1.12	1.12	1.12
S, %	2.06	2.06	2.06
Zn, mg/kg	3,405	3,405	3,405
Fe, mg/kg	1,702	1,702	1,702
Mn, mg/kg	3,405	3,405	3,405
Cu, mg/kg	851	851	851
I, mg/kg	74.5	74.5	74.5
Co, mg/kg	17	17	17
Se, mg/kg	28.1	28.1	28.1
Vitamin A, IU/kg	375,634	375,634	375,634
Vitamin D, IU/kg	47,042	47,042	47,042
Vitamin E, IU/kg	469	469	469
Lasalocid, mg/kg	—	1,764	—
Monensin, mg/kg	—	—	1,764

[a]Beef Grower, AKEY, Inc., Lewisburg, OH.
[b]Beef Grower Bov, AKEY, Inc., Lewisburg, OH.
[c]Beef Grower R, AKEY, Inc., Lewisburg, OH.

Table 2. Intake of dry matter (kg) by heifers during the first 5-d feeding segment in Exp. 1

Heifer	Treatment diets[a]				
	Control	1M	2M	1L	2L
1	12.88	8.23	3.47	8.80	8.04
2	5.12	5.11	4.02	3.86	4.59
3	7.38	5.22	6.27	5.66	7.88
4	6.24	5.66	6.40	7.21	5.38
5	6.24	6.06	5.80	5.52	7.07
6	6.58	6.59	5.61	5.72	5.84
Total[b]	44.44	36.87	31.57	36.77	38.80
Mean[c]	1.50	1.23	1.05	1.23	1.29

[a]M = monensin, and L = lasalocid; 1 = 1 mg/kg BW daily, and 2 = 2 mg/kg BW daily.
[b]Total DM consumed by all heifers for each treatment diet during the first 5 d.
[c]Mean quantity of DM consumed for each treatment diet daily by each heifer during the first 5 d.

Materials and Methods

Experiment 1

Animals and Treatment Diets. Six 5-mo-old Holstein heifers (220 ± 14 kg of BW) were used for the experiment. The heifers were housed in a naturally ventilated free-stall barn until their participation in the experiment. During the experiment, the heifers were housed in an individual 4.6 × 4.6 m pen in the free-stall barn.

The treatments were control (no ionophore), 1 mg of lasalocid/kg of $BW^{-1}{\cdot}d^{-1}$ (**1L**), 2 mg of lasalocid/kg of $BW^{-1}{\cdot}d^{-1}$ (**2L**), 1 mg of monensin/kg of $BW^{-1}{\cdot}d^{-1}$ (**1M**), and 2 mg of monensin/kg of $BW^{-1}{\cdot}d^{-1}$ (**2M**). The 1L and 1M treatments were chosen because they are similar to the amounts required to control and prevent coccidiosis. The 2L and 2M treatments were used to determine whether twice the required amount of ionophore affected taste preference. Ionophores were provided as part of the mineral mix for treatments 1L and 1M. The chemical composition of the mineral mixes is shown in Table 1. Control mineral was added at the same rate as the 1 mg/kg BW ionophore treatment. To make the 2L and 2M treatments, either lasalocid (6.62 g/kg; Bovatec 3GM; Akey, Inc., Lewisburg, OH) or monensin (6.62 g/kg; Rumensin 3GM, Akey Inc.) in the form of supplemental ionophore was added to the 1L or 1M treatment, respectively. These supplements provided only ionophore and a processed-grain by-product. Treatments were mixed into the basal diet by hand in each individual feed tub. The heifers were fed a total mixed ration containing (DM basis) 46% corn silage, 46% grass haylage, and 8% soybean meal. The diet analyzed 38.5% DM and (DM basis) 46.1% NDF, 31.0% ADF, 14.9% CP, and 2.2% fat. The basal diet was considerably different from that fed to the heifers before their use in this study, which consisted of a mostly grass silage diet with added mineral and vitamins. This diet was fed for the previous 3 mo to each heifer. The basal diet was changed to decrease any potential bias. Heifers were fed diets containing lasalocid in a mineral mix before being used in experiment; however, the mineral mix fed to the heifers before being used in this experiment was from a different source.

The pen and experimental setup were similar to that described by Nombekela et al. (1994). There was a manger on one side of the pen opposite the water supply. The manger was 69 cm wide × 395 cm long ± 61 cm high and contained seven containers. Each container was 27 cm deep × 42 cm wide × 47 cm long. An empty container was included on each end to nullify border effects.

Feeding and Experimental Design. Heifers were fed at 0730 and 1930. The containers were positioned randomly at each feeding within the manger. The same amount of feed was added to each container and was calculated to provide 10% orts for every diet. Feed offered and orts were weighed and recorded at each feeding. Enough feed was provided in each container to allow consumption of only that feed if the heifer chose to consume only the feed in that particular container. All five diets were offered for 7 d, with the first 2 d for adaptation. The experimental period was from d 1 to the end of d 14. At the end of each feeding segment (d 5, 9, 12), the most preferred diet was eliminated sequentially. The empty tubs were placed on either end of the manger. The ranking of the last two treatment diets was determined at the end of d 14. Therefore, five treatments were offered for 5 d, four

Table 3. Average dry matter intake by each heifer for each feeding segment in Exp. 1

Segment	Days of experiment	Heifer 1	2	3	4	5	6
		(DMI, kg/d)					
1	1 to 5	7.05	5.21	6.75	6.45	6.04	6.24
2	6 to 9	8.02	5.10	6.72	6.00	6.08	6.96
3	10 to 12	7.97	5.57	6.67	7.00	6.43	6.98
4	13 to 14	7.40	6.14	6.84	6.70	6.08	6.72
Mean		7.57	5.39	6.74	6.48	6.14	6.67

treatments for 4 d, three treatments for 3 d, and two treatments for 2 d.

Sampling and Other Measurements. Feed and ort samples were collected daily and pooled over the entire 16-d feeding period. The composited samples were dried in a vacuum oven at 60°C for 24 h and ground to pass a 1-mm screen using a Wiley Mill (Thomas Scientific, Swedesboro, NJ). Dried and ground samples were analyzed for CP (Noel, 1979), fat (AOAC, 1995), NDF, and ADF (Goering and Van Soest, 1970).

The BW of each heifer was estimated with a calibrated heifer weigh tape on two consecutive days before the experiment. An electronic scale could not be used because of a malfunction and was not replaced until after the conclusion of the experiment. These initial BW measurements were averaged to determine the quantity of mineral mix, mineral mix containing ionophore (1L, 1M), and additional ionophore (2L, 2M) to be provided during the 14-d experimental period.

Experiment 2

This experiment was conducted because heifers used in Exp. 1 had previous exposure to lasalocid.

Animals, Diets, Feeding, and Experimental Design. Six 6-wk-old Holstein calves (75 ± 5 kg of BW) were used to test the preference for control, 1L, or 1M. Treatments were determined in the same manner as in Exp. 1. Calves did not have previous exposure to either ionophore and were fed milk and calf starter grain containing decoquinate (50 mg/kg) as an anticoccidial before the study. The starter grain consisted of molasses, pellets and steam-flaked corn. The DM, CP, NDF, and fat contents (DM basis) were 91.9, 22.3, 21.7, and 4.2%, respectively. Calves were weaned at 6 wk and placed in an individual super calf hutch (CalfTel, Germantown, WI), bedded with kiln-dried wood shavings with free choice water available. The dimensions of the hutch were 272 cm × 216 cm × 193 cm. The attached pen dimensions were 272 cm × 310 cm. The same cafeteria-style feeder used in Exp. 1 was used, except that the feeding tubs were covered to allow calves access while keeping rain out of the feeder. A similar starter grain was used during the preference study as was fed before the experiment, except that it did not contain decoquinate. As in Exp. 1, calves had access to treatments at all times, except that in this study, calves had three choices instead of five. Wooden dividers were used to force the feed toward the front of each tub to allow the calves access to the feeder. Intake was determined daily at 0700, with the first day used for adaptation to surroundings with all feeds available. Feed was fed in the same manner as in Exp. 1. Ionophores were top dressed and mixed in by hand. A corn meal carrier (5 g) was used, and the control treatment was the corn meal carrier alone. After 3 d, the treatment with the overall greatest consumption was removed. An empty container was used for that treat-

Table 4. Number of days when treatments were chosen as first preference by heifers during the first 5-d feeding segment in Exp. 1

Heifer	Treatment diets[a] Control	1M	2M	1L	2L
1	2	1	—	1	1
2	2	1	—	—	2
3	2	—	—	1	2
4	2	1	1	1	—
5	1	1	1	—	2
6	1	2	—	—	2
Days	10	6	2	3	9
Mean[b]	1.7	1	0.33	0.5	1.5

[a]M = monensin, L = lasalocid, 1 = 1 mg/kg BW daily, and 2 = 2 mg/kg BW daily.
[b]Mean = the average number of days a treatment was chosen per heifer.

Table 5. Ranking of treatments over all the feeding segments in Exp. 1

Heifer	Treatment diets[a] Control	1M	2M	1L	2L
1	1	5	4	2	3
2	1	4	5	2	3
3	3	4	5	2	1
4	2	3	5	1	4
5	3	5	2	4	1
6	5	1	2	4	3
Sum	15	22	23	15	15
Mean	2.5	3.67	3.83	2.5	2.5

[a]Rank of the treatment diets is given, with 1 = most preferred and 5 = least preferred. M = monensin, L = lasalocid, 1 = 1 mg/kg BW daily; 2 = 2 mg/kg BW daily.

Table 6. Chances of a diet being chosen first for the ionophore study (Exp. 1)

Treatment[a]	μ[b]	SE[c]	Z[d]	*P*
Control	27.8	11.5	0.68	≤0.497
1M	8.6	5.1	–2.23	≤0.026
2M	6.4	4.3	–3.18	≤0.002
1L	30.8	11.6	0.93	≤0.352
2L	26.3	11.3	0.56	≤0.575

[a]M = monensin, L = lasalocid, 1 = 1 mg/kg BW daily, and 2 = 2 mg/kg BW daily.
[b]μ = the estimated percent chance that a treatment diet will be chosen first when all five treatment diets are offered together.
[c]SE = standard error for the chance a treatment diet will be chosen first.
[d]Z tests whether μ is different from 20% (the percent chance a diet will be chosen if there were no preferences).

ment. During the last 2 d, the remaining two treatments were used to determine second preference.

Statistical Analyses. Heifer preferences were analyzed by ranking the diets from most to least preferred. Agreement among heifers was calculated using Kendall's coefficient of concordance, W (Nombekela et al., 1994). The Plackett-Luce model (Fligner and Verducci, 1988) was then used to estimate the probability that a diet in the tested set would be chosen first based on the rankings. For Exp. 1 with five diets, the appropriate test was whether the estimated preference differed from the 20% that would have been expected if there were no preferences (100/5). Orthogonal contrasts compared 1) the control diet vs. diets containing ionophores; 2) monensin vs. lasalocid diets; 3) amount of ionophore supplemented; and 4) tested the interactions of ionophore and their concentration.

For Exp. 2, with three diets, the appropriate test was whether the estimated preference differed from the 33.33% that would be expected if there were no preferences (100/3). Orthogonal contrasts compared 1) the control diet vs. diets containing ionophores and 2) monensin vs. lasalocid.

Table 7. Orthogonal contrasts for the treatment diets during the experimental period for the ionophore study (Exp. 1)

Contrasts	Est[a]	SE[b]	Z[c]	*P*
Control vs. ionophore	–9.81	14.43	–0.68	NS[d]
Monensin vs. lasalocid	–21.04	8.02	–2.62	≤0.009
1 vs. 2[e]	3.31	10.32	0.32	≤0.749
Interaction	–1.15	10.20	–0.11	≤0.912

[a]Est = the estimated contrasts.
[b]SE = standard error for the contrasts.
[c]Z tests the significance of the contrast.
[d]NS = not significant, $P > 0.15$.
[e]1 mg/kg BW of ionophore daily, and 2 = 2 mg/kg BW of ionophore daily.

Table 8. Intake of dry matter (kg) by heifers during the first 3-d feeding segment of ionophore preference in Exp. 2

	Treatment diets[a]		
Heifer	Control	1M	1L
1	7.30	1.89	3.69
2	6.58	3.69	3.15
3	5.95	5.22	2.43
4	3.96	2.52	4.86
5	4.14	1.44	5.41
6	3.06	3.80	1.98
Total[b]	30.99	18.56	21.52
Mean[c]	1.72	1.03	1.20

[a]Mean = monensin, L = lasalocid, 1 = l mg/kg BW daily.
[b]The total DM consumed by all heifers for each treatment diet during the first 3 d.
[c]The mean quantity of DM consumed for each treatment diet per day by each heifer during the first 3 d.

Results

Experiment 1

The DMI of the five diets during the first feeding segment (5 d) of sequential elimination are presented in Table 2. Over the 5-d period, the control treatment was numerically preferred, followed by the 2L treatment.

The overall DMI by the heifers for each feeding segment within the 14-d experimental period is presented in Table 3. Intakes of DM seemed to be within a reasonable range for the size of the heifers. The heifers averaged 6.50 ± 0.76 kg of DM/d, and the elimination of a preferred diet did not adversely affect the mean daily DMI, indicating that, when the most preferred diet was removed, cattle consumed amounts of DM similar to those when it was present.

The total and mean number of days during which diets were chosen first by individual heifers during the first 5-d segment are presented in Table 4. Control treatment ranked first on 10 heifer days, followed by 2L that ranked first for nine, 1M for six, 1L for three, and 2M for two heifer days. Heifers preferred the 2L treatment over the other ionophore treatments. However, when diets were ranked according to consumption, heifers did not differentiate among the lasalocid treatments and control, and ranked these treatments high (most preferred; Table 5). Heifers ranked the monensin treatments low (least preferred); however, because there were ties among the treatment ranks (control, 1L, and 2L), Kendall's coefficient of concordance was not significant between treatments (W = 0.189).

To further evaluate these responses, ∝, the chance that diets would be equally preferred during the trial, was determined. If this were the case, then ∝ would equal 20% for each diet (Table 6). Results indicated that μ for treatments 1M (∝ = 8.6) and 2M (∝ = 6.4) differed ($P < 0.05$ and $P < 0.01$, respectively) from 20%. The 1L had the greatest chance of being chosen first

Table 9. The average dry matter intake (kg/d) by each heifer for each feeding segment in Exp. 2

Segment	Days of experiment	Heifer					
		1	2	3	4	5	6
1	1 to 3	4.30	4.48	4.21	3.78	3.67	2.82
2	4 to 5	6.46	5.68	5.38	4.50	2.43	3.81
Mean		5.39	5.08	4.79	4.14	3.05	3.32

$\propto$ = 30.8), followed by the control and 2L ($\propto$ = 27.8, and 26.3, respectively); however, none of these differed from chance (20%), indicating that the chances of control, 1L, or 2L being chosen first were similar.

Orthogonal comparisons (Table 7) indicated that there were no differences between control vs. the average of the other treatments, or the two concentrations of ionophore (1L, 1M vs. 2L, 2M). There was also no interaction of ionophore and the concentration at which it was fed; however, averaging across concentrations, lasalocid was preferred over monensin (Z = –2.62, $P < 0.01$).

Experiment 2

The DMI of the three diets during the first feeding segment (3 d) of sequential elimination Exp. 2 are presented in Table 8. Over the 3-d period, the control treatment was preferred, followed by the 1L treatment. These calves did not have previous exposure to ionophore, and the results support those of Exp. 1.

The overall DMI by the heifers for each feeding segment within the 5-d experimental period is presented in Table 9. The heifers averaged 4.29 ± 1.10 kg of DM/d, and the elimination of a preferred diet did not adversely affect mean daily DMI. As stated previously for Exp. 1, when the most preferred diet was removed, cattle still consumed amounts of DM similar to when it was present.

The total and mean number of days during which diets were chosen as first preference by individual heifers during the first 3-d segment are presented in Table 10. The control treatment ranked first on nine heifer days, followed by 1L with seven, and 1M with two heifer days. When diets were ranked according to consumption, heifers ranked treatments in the following order: control, 1L, and 1M (Table 11).

As in Exp. 1, the chance that diets would be chosen first among those tested ($\propto$ = 33.33% if equally preferred in this case) was estimated (Table 12). At 60.7%, a tendency (P = 0.12) for the control diet to chosen first was indicated. The $\propto$ for 1L did not differ from 33.33; however, the probability that 1M would be chosen first (12.2%) was less than 33.33% ($P < 0.05$).

Orthogonal contrasts (Table 13) confirmed the tendency for the control diet to be preferred over diets containing ionophores (P = 0.12), but at a dosage of 1 mg/kg of BW and in a design less sensitive than Exp. 1, we did not detect a difference between preference for lasalocid and monensin.

Discussion

In both experiments, heifers preferred the nonmedicated control treatment to either ionophore treatment when given a choice. In both studies, heifers ranked lasalocid over monensin. Producers often experience a decrease in DMI when cattle are fed ionophores compared with nonmedicated feeds. The purpose of this study was to determine whether ionophores elicited a short-term aversion to the diet fed.

Table 10. The number of days during which treatments were chosen as first preference by heifers during the first 3-d feeding segment in Exp. 2

Heifer	Treatment diets[a]		
	Control	1M	1L
1	2	0	1
2	3	0	0
3	1	2	0
4	1	0	2
5	0	0	3
6	2	0	1
Days	9	2	7
Mean[b]	1.5	0.33	1.17

[a]M = monensin, L = lasalocid, 1 = 1 mg/kg BW daily.
[b]Mean = the average number of days a treatment was chosen per heifer.

Table 11. Ranking of treatments over all the feeding segments in Exp. 2

Heifer	Treatment diets[a]		
	Control	1M	1L
1	1	3	2
2	1	3	2
3	2	1	3
4	2	3	1
5	2	3	1
6	1	2	3
Sum	9	15	12
Mean	1.5	2.5	2.0

[a]Mean = monensin, L = lasalocid, 1 = 1 mg/kg BW daily. Rank of the treatment diets is given, with 1 = most preferred and 3 = least preferred.

Table 12. Chances of a diet being chosen first for the ionophore study (Exp. 2)

Treatment[a]	μ[b]	SE[c]	Z[d]	*P*
Control	60.7	17.3	1.59	<0.12
1 L	27.1	14.5	–0.43	NS[e]
1 M	12.2	8.8	–2.40	<0.05

[a]M = monensin and L = lasalocid; 1 = 1 mg/kg BW daily.
[b]μ = the estimated percentage chance that a treatment diet will be chosen first when all three treatment diets are offered together.
[c]SE = standard error for the chance a treatment diet will be chosen first.
[d]Z tests whether μ is different from 33.33% (the percentage chance a diet will be chosen if there were no preferences).
[e]NS = not significant, $P > 0.15$.

These results seem reasonable because other studies have shown that cattle supplemented with monensin and not given a choice consume less DM than cattle fed a control diet (Baile et al., 1979) or a diet supplemented with lasalocid (Thonney et al., 1981). The NRC (1996) suggests decreasing predicted DMI by beef cattle fed monensin, but indicated no adjustment for cattle fed lasalocid or laidlomycin. Preferences were similar between the DMI of 1M and 1L diets in the first feeding segment in Exp. 1. In studies evaluating dairy heifers fed monensin (Baile et al., 1982) or lasalocid (Steen et al., 1992), DMI was not decreased compared with controls.

In studies with lactating dairy cows, DMI either was not changed (Erickson et al., 2000), increased (Knowlton et al., 1996), or decreased (Erasmus et al., 1999) when lasalocid was fed in a total mixed ration compared with dairy cows fed a control diet. Cows in early lactation and fed approximately 400 mg/d of monensin consumed 1.2 kg/d less feed DM than cows fed a control diet (Sauer et al., 1989).

Baile et al. (1979) observed that steers reacted differently to monensin when it was fed as Rumensin vs. monensin sodium. Dry matter intake was decreased when Rumensin was added to the feed, regardless of whether a high-concentrate (85% concentrate) or high-forage (8% concentrate) diet was fed. Dry matter intake was not decreased when monensin sodium was injected into the rumen over a 6-h period in cattle fed the high-roughage diet, but it was reduced when cattle were fed the high-concentrate diet. Cattle fed Rumensin had a lower number of prehension bouts when fed the high-concentrate diet. Infusing monensin sodium (250 mg) directly into the rumen over a 6-h period caused a decrease in DMI after the cessation of the infusion, when the cattle were returned to the control diet. These results suggest that a physiological response to monensin sodium is subsequent to decreased DMI. Nonetheless, when monensin sodium was added to the feed in place of Rumensin, DM was similar between control cattle and those cattle fed monensin sodium, suggesting that the aversion may not be to the chemical itself, but to a component of the Rumensin premix.

Table 13. Orthogonal contrasts for the treatment diets during the experimental period for the ionophore study (Exp. 2)

Contrasts	Est[a]	SE[b]	Z[c]	*P*
Control vs. ionophore	41.1	25.9	1.59	<0.12
Monensin vs. lasalocid	7.4	8.3	0.90	NS[d]

[a]Est = the estimated contrasts.
[b]SE = the standard error for the contrasts.
[c]Z tests the significance of the contrast.
[d]NS = not significant, $P > 0.15$.

When cattle are provided with a choice of feeds, they will consume the one that is most preferred; however, in these experiments, heifers continued to consume DM at similar amounts as compared with the portion of the experimental period when the most preferred feed was present. This implies that there is a difference between palatability and voluntary feed intake. Cattle fed the less palatable treatments still consumed as much feed as those when given a choice. Therefore, enhanced palatability does not necessarily imply enhanced DMI.

Implications

Two preference studies were conducted to evaluate taste differences between nonmedicated, lasalocid- or monensin-supplemented feeds for dairy heifers. Results from both experiments indicated that dairy heifers prefer nonmedicated feeds over medicated feeds, followed by a preference for lasalocid and monensin. In both studies, total mixed rations containing monensin were estimated to be chosen first <13% of the time when either a nonmedicated or lasalocid-containing total mixed ration was available.

Literature Cited

AOAC. 1995. Official Methods of Analysis. 16th.ed. Assoc. Off. Anal. Chem., Arlington, VA.

Baile, C. A., C. L. McLaughlin, W. V. Chalupa, D. L. Snyder, L. C. Pendlum, and E. L. Potter. 1982. Effects of monensin fed to replacement dairy heifers during the growing and gestation period upon growth, reproduction, and subsequent lactation. J. Dairy Sci. 65:1941–1944.

Baile, C. A., C. L. McLaughlin, E. L. Potter, and W. Chalupa. 1979. Feeding behavior changes of cattle during introduction of monensin with roughage or concentrate diets. J. Anim. Sci. 48:1501–1508.

Erasmus, L. J., I. Smith, A. Muller, and D. O'Hagan. 1999. Effects of lasalocid on performance of lactating cows. J. Dairy Sci. 82:1817–1823.

Erickson, P. S., M. R. Murphy, J. M. Campbell, and S. W. Nombekela. 2000. Lasalocid supplementation of dairy cow diets in early lactation. Prof. Anim. Sci. 16:196–201.

Fligner, M. A., and J. S. Verducci. 1988. Multistage ranking models. J. Am. Stat. Assoc. 83:892–901.

Goering, H. K., and P. J. VanSoest. 1970. Forage Fiber Analyses (Apparatus, Reagents, Procedures, and Some Applications). Agric. Handbook No. 379. ARS, USDA, Washington, DC.

Knowlton, K. F., M. S. Allen, and P. S. Erickson. 1996. Lasalocid and particle size of corn grain for dairy cows in early lactation. 1. Effect on performance, serum metabolites, and nutrient digestibility. J. Dairy Sci. 79:557–564.

NRC. 1996. Nutrient Requirements of Beef Cattle. 7th rev. ed. Natl. Acad. Press, Washington, DC.

NRC. 2001. Nutrient Requirements of Dairy Cattle. 7th rev. ed. Natl. Acad. Press, Washington, DC.

Noel, R. 1979. Determination of crude protein in animal feeds, using block digestion followed by steam distillation: Collaborative study. J. Assoc. Off. Anal. Chem. 62:290–291.

Nombekela, S. W., M. R. Murphy, H. W. Gonyou, and J. I. Marden. 1994. Dietary preferences in early lactation cows as affected by primary tastes and some common feed flavors. J. Dairy Sci. 77:2393–2399.

Sauer, F. D., J. K. G. Kramer, and W. J. Cantwell. 1989. Antiketogenic effects of monensin in early lactation. J. Dairy Sci. 72:436–442.

Steen, T. M., J. D. Quigley, III, R. N. Heitmann, and J. D. Gresham. 1992. Effects of lasalocid and undegradable protein on growth and body composition of Holstein heifers. J. Dairy Sci. 75:2517–2523.

Thonney, M. L., E. K. Heide, D. J. Duhaime, R. J. Hand, and D. J. Perosio. 1981. Growth, feed efficiency and metabolite concentrations of cattle fed high forage diets with lasalocid or monensin supplements. J. Anim. Sci. 52:427–433.