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TOTAL MIXED RATIONS FOR FEEDING DAIRY HEIFERS FROM 3 TO 6 MONTHS OF AGE

H. Terui, J. L. Morrill, and J. J. Higgins¹

Summary

Total mixed rations (TMR) with different forage (F):concentrate (C) ratios were fed to Holstein heifers (n = 135) 12 to 24 wk of age. In four trials, the heifers were divided into different age groups and fed three different F:C ratios. Based on the results, the following recommendations are made.

First, if facilities are available for only two groups from 12 to 24 wk of age and heifers are at the desired body weight (BW) at 12 wk of age, they should be fed a diet similar to the experimental TMR 50:50 with a F:C ratio of 50:50 from 12 to 18 wk of age. For the next 6 wk, the heifers should be kept on the same diet or changed to a higher or lower concentration of energy, depending on their condition at the time, which will be a function of the quality of ingredients (primarily, the roughage) used in the diet. Feed consumption will be about 9 lb/head/day for heifers 12 to 18 wk of age, and 12 to 13 lb/head/day for heifers 18 to 24 wk of age.

Second, if facilities allow for three groups from 12 to 24 wk of age and the heifers are at the desired BW at 12 wk of age, the diet should contain approximately 33, 50, and 70% hay for heifers 12 to 16, 16 to 20, and 20 to 24 wk of age, respectively. If heifers are not at the desired BW at 12 wk of age, they should stay on the 33:67 diet until they reach desirable weight. Feed consumptions will be about 8 to 9 lb/head/day for heifers 12 to 16 wk of age, 10 to 12 lb/head/day from 16 to 20 wk of age, and 12 to 14 lb/head/day from 20 to 24 wk of age.

(Key Words: Total Mixed Ration, Heifer, Forage:Concentrate Ratio.)

Introduction

Use of TMR for feeding lactating cows has become common in most parts of the United States and some other parts of the world. However, feeding TMR to dairy heifers 12 to 24 wk of age has not been evaluated adequately. To formulate TMR for heifers, dry matter (DM) consumption at the different ages with different ratios of F and C must be known. Dairy heifers should gain approximately 1.7 lb per day from 12 to 24 wk of age and weigh approximately 380 lb by 24 wk of age. Desirable F to C ratios should be determined to achieve that daily gain.

The objective of this experiment was to determine the proper F:C ratio for dairy heifers from 12 to 24 wk of age as measured by BW, body condition score (BCS), average daily gain (ADG), and DM intake.

Procedures

Holstein heifers (n = 135) at the Kansas State University Dairy Research Center were used. In four trials, different F to C ratios used were 33:67, 50:50, and 70:30 (Table 1). In each trial, fresh TMR was always available in the feed bunk. Water was available ad libitum. Feed refusals, BW, and BCS, were measured weekly.

Four pens were available for use; thus, in each trial the heifers were divided into four groups that differed in ages and/or feed consumed.

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Trial 1. Data were collected on 61 heifers during the time they were in one of four groups: 12 to 18 wk of age fed 33:67; 12 to 18 wk of age fed 50:50; 18 to 24 wk of age fed 33:67; or 18 to 24 wk of age fed 50:50. Heifers started on 33:67 stayed on that ratio when they reached 18 wk of age but were moved to the pen with heifers 18 to 24 wk of age, and heifers started on 50:50 stayed on that ratio, but were moved to another pen, when they reached 18 wk of age.

Trial 2. Heifers ($n = 21$) were assigned to one of four groups: 12 to 18 wk of age, fed F:C ratio of 33:67; 12 to 18 wk of age, fed 50:50; 18 to 24 wk of age, fed 70:30; and 18 to 24 wk of age, fed 50:50. Heifers on 33:67 from 12 to 18 wk of age were assigned to 70:30 from 18 to 24 wk of age and moved to another pen with heifers 18 to 24 wk of age, and heifers started on 50:50 stayed on that ratio, in another pen, from 18 to 24 wk of age.

Trial 3. The heifers ($n = 26$) were assigned randomly to four groups. All heifers were fed 33:67 from 12 to 20 wk of age, but were in different groups from 12 to 16 wk and from 16 to 20 wk of age. At 20 wk of age, the heifers were assigned either to be fed a 50:50 or 70:30 TMR according to their BW. If the heifer was lighter than the desirable BW (328 lb), she was assigned to 50:50 and moved to the pen with heifers 20 to 24 wk of age. If heavier, she was assigned to 70:30 and moved to another pen.

Trial 4. Heifers ($n = 27$) were grouped following the same procedure as trial 3, except they were assigned randomly either to be fed a 50:50 or 70:30 TMR when they were 20 wk of age.

Results and Discussion

Trial 1. Figure 1 shows weekly BW. Average wt of heifers was less than desirable at 12 wk of age. From 12 to 16 wk of age, gain of the heifers was similar and acceptable for heifers of that age (Table 3) but was not sufficient to bring heifers to desirable BW at 16 wk of age. From 16 wk of age until 24 wk of age, growth of heifers fed 33:67 was above normal for that age and allowed the heifers to reach desirable BW by 24 wk of age. The gain of heifers fed 50:50 was adequate but was less

($P < .05$) than that of heifers fed 33:67 from 16 to 24 wk of age and did not allow them to reach desirable BW by 24 wk of age. Heifers fed 33:67 consumed more ($P < .05$) feed between 18 and 24 wk of age than those fed 50:50 (Table 2). No significant difference was observed in BCS during the trial (Table 3).

Trial 2. Figure 2 shows weekly BW. Average BW of heifers assigned to 33:67 was below normal at the start of the trial but close to the desired BW by 18 wk of age. Heifers assigned to 50:50 were close to desirable BW at 12 wk of age and remained close to desirable BW during the entire 12 wk. The heifers changed from 33:67 to 70:30 reached desirable BW by 20 wk of age and were close to desirable BW by 24 wk of age.

Trial 3. Figure 3 shows weekly BW. The average BW of the heifers was close to, but slightly below, desirable BW at the beginning of the trial and stayed slightly below desirable BW throughout the 6 wk that they were fed 33:67. From 20 to 24 wk of age, BW of heifers fed 70:30 was more ($P < .01$) than that of heifers fed 50:50. This difference was expected at the beginning, because the heifers were separated according to size; however, we expected that the difference in BW between groups would decrease, because the lighter wt heifers were fed a ration with higher energy concentration. Why the difference did not decrease could not be explained by feed consumption, because both groups consumed the same (Table 2). The heifers fed 70:30 consumed less protein than the other group; therefore, protein intake could not explain their better performance. They may have used feed more efficiently, and this may have been why they were larger than heifers assigned to the 50:50 TMR.

Trial 4. Heifers used in Trial 4 were at the desired BW at 12 wk of age (Figure 4) and wt gains from 12 to 20 wk of age were above the desired rate of gain (Table 3), resulting in heifers that were, on the average, slightly above desired BW at 20 wk of age. From 20 to 24 wk of age, heifers fed 50:50 consumed more ($P < .01$) feed (Table 2). Weight gains of both groups were above 1.7 lb per day (Table 3), and heifers fed the 50:50 seemed to gain more.

Intake of nutrients depends on diet formulation and amount of that diet consumed. Intake of diet will depend on quality of ingredients, as well as management and environmental factors; thus, intake of a given formulation will not be a constant. Therefore, there are limitations in adapting these results to a specific location. With these qualifications in mind, these data should be useful in formulating TMR for heifers of this age, and the following recommendations are presented.

First, if facilities are available for only two groups from 12 to 24 wk of age and heifers are at the desired body weight (B W) at 12 wk of age, they should be fed a diet similar to the experimental TMR 50:50 from 12 to 18 wk of age. For the next 6 wk, the heifers should be kept on the same diet or changed to a higher or lower concentration of energy, depending on the condition of their at the time, which will be a function of the quality of ingredients (pri-

marily, the roughage) used in the diet. Feed consumption will be about 9 lb/head/day for heifers 12 to 18 wk of age and 12 to 13 lb/head/day for heifers 18 to 24 wk of age.

Second, if facilities allow for three groups from 12 to 24 wk of age and the heifers are at the desired BW at 12 wk of age, the diet should contain approximately 33, 50, and 70% hay for heifers 12 to 16, 16 to 20, and 20 to 24 wk of age, respectively. If heifers are not at the desired BW at 12 wk of age, they should stay on the 33:67 diet until they reach desirable weight. Feed consumption will be about 8 to 9 lb/head/day for heifers 12 to 16 wk of age, 10 to 12 lb/head/day from 16 to 20 wk of age, and 12 to 14 lb/head/day from 20 to 24 wk of age.

At all times, the individual heifers should be observed and should be changed to a different diet if condition is above or below that desired.

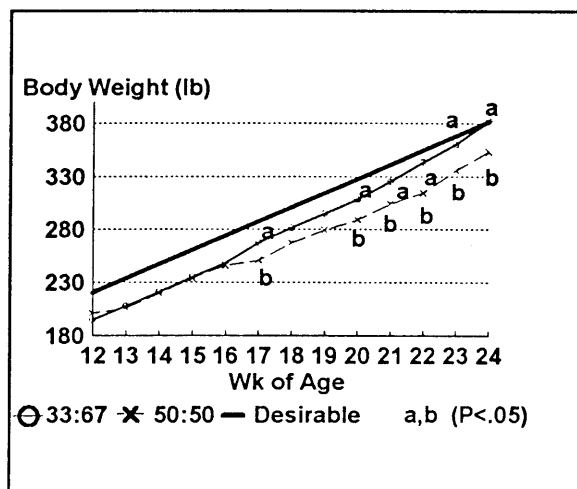


Figure 1. Weekly Body Weight from 12 to 24 Wk of Age (Trial 1)

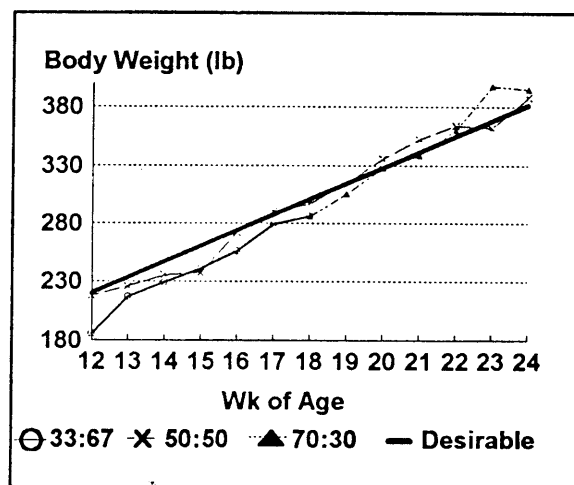


Figure 2. Weekly body Weight from 12 to 24 Wk of Age (Trial 2)

Table 1. Composition of Total Mixed Rations (TMR) on a Dry Matter (DM) Basis

Item	Forage:concentrate ratio		
	33:67	50:50	70:30
Ingredients	----- % -----		
Alfalfa hay	32.1	47.1	69.0
Molasses	1.2	1.1	2.2
Corn	55.6	46.6	28.0
SBM 44	10.8	4.7	-
Ca-P supplement (18% Ca 22% P)	.14	.25	.06
Se supplement 600 ppm	.01	.10	.01
TM Salt	.14	.13	.10
Lasalocid 68 g/lb	.02	.02	.01
Vitamin E 2000 IU/lb	—	—	.05
Chemical Composition	----- % -----		
DM	88.2	89.0	89.3
NDF	21.2	24.3	36.4
ADF	11.5	17.1	28.4
CP	17.6	15.8	15.5

Table 2. Average Feed Consumption in Four Trials

Week of age	Forage:concentrate ratio			SE
	33:67	50:50	70:30	
Trial 1	----- lb/head/day -----			
12 to 18	8.7	7.9	—	.3
18 to 24	12.2 ^c	11.4 ^d	—	.3
Trial 2				
12 to 18	9.0	8.5	—	.4
18 to 24	—	13.1	11.7	.4
Trial 3				
12 to 16	8.4	—	—	.5
16 to 20	10.7	—	—	.5
20 to 24	—	12.2	12.2	.5
Trial 4				
12 to 16	9.6	—	—	.4
16 to 20	12.1	—	—	.4
20 to 24	—	14.6 ^a	12.5 ^b	.4

^{a,b}Means within a row without a common superscript letter differ (P<.01).

^{c,d}Means within a row without a common superscript letter differ (P<.05).

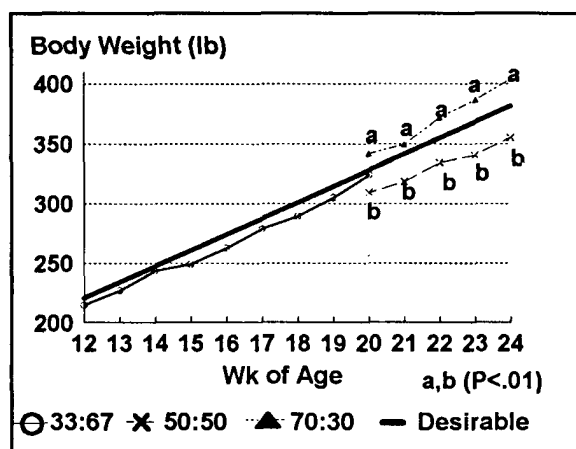


Figure 3. Weekly Body Weight from 12 to 24 Wk of Age (Trial 3)

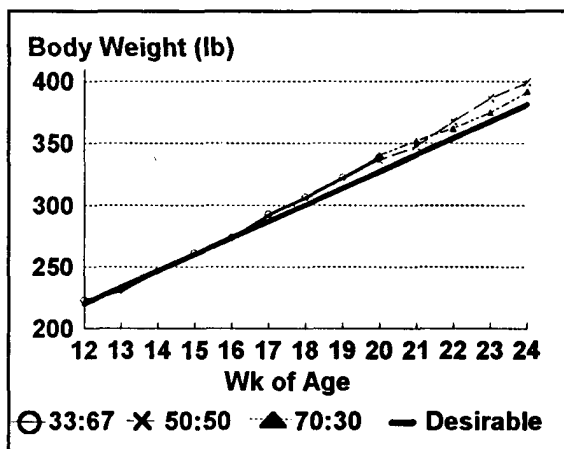


Figure 4. Weekly Body Weight from 12 to 24 Wk of Age (Trial 4)

Table 3. Body Condition Score and Average Daily Gain of Heifers in Four Trials

Week of age	Forage:concentrate ratio			SE
	33:67	50:50	70:30	
----- Body condition scores -----				
Trial 1				
12 to 18	3.1	3.0	—	.1
18 to 24	2.8	2.8	—	.1
Trial 2				
12 to 18	2.8	2.8	—	.1
18 to 24	—	3.2	3.0	.2
Trial 3				
12 to 16	2.9	—		.1
16 to 20	2.9	—		.1
20 to 24	—	3.0	3.1	.1.
Trial 4				
12 to 16	2.9	—	—	.3
16 to 20	3.0	—	—	.3
20 to 24	—	3.3	3.1	.1
----- Average daily gain (lb/day) -----				
Trial 1				
12 to 18	2.0	1.9	—	.1
18 to 24	2.6 ^a	2.1 ^b	—	.1
Trial 2				
12 to 18	1.9	1.7	—	.4
18 to 24	—	2.3	1.8	.5
Trial 3				
12 to 16	2.0	—		.2
16 to 20	2.7	—		.1
20 to 24	—	1.9	2.2	.3
Trial 4				
12 to 16	2.0	—	—	.1
16 to 20	2.3	—	—	.1
20 to 24	—	2.5	2.0	.4

^{a,b}Means within a row without a common superscript letter differ ($P < .01$).