

Effect of a simplified “stair-step” feeding system on the performance of Red-and-White × Holstein-Friesian heifers*

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ABSTRACT

Eighteen Red-and-White × Holstein-Friesian heifers were assigned to two analogous groups (9 animals each), in which two different feeding levels were used from 6 to 11 (period 1) and from 12 to 13 (period 2) months of age: the control group (C) received the ration recommended by IZ-INRA standards for a daily gain of 700 g; the experimental group (E), a stair-step regimen in which the feeding level was 15% lower in period 1 and then 15% higher in period 2 compared with the control group. From 14 months of age to day 100 of lactation, all groups were fed according to IZ-INRA standards. It was found that the diverse feeding level of heifers prior to and after the pubertal period resulted in higher milk yield and secretory tissue content in the udder.

KEY WORDS: heifers, primiparous, growth, stair step system, milk yield, udder

INTRODUCTION

Park et al. (1987) showed better development of the mammary gland and higher milk yield in HF heifers on a stair-step feeding system compared with standard feeding (NRC, 1989) according to the linear growth curve. However, it is difficult to apply the traditional stair-step feeding regimen in consecutive developmental periods, i.e. sexual maturation, reproduction, pregnancy, in commercial herds of dairy cattle (Hoffman, 1997).

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The aim of the study was to determine the extent to which a simplified stair-step regimen applied only in the period before and after puberty affects the growth, milk yield and proportion of secretory and adipose tissue in the udder of Red-and-White primiparous cows with high Holstein-Friesian breeding.

MATERIAL AND METHODS

The experiment was carried out on 18 Red-and-White primiparous cows (52.5-87% HF Red) during rearing and the first 100 days of lactation, allotted to two analogous groups of 9 each. Animals in the control group (C) were fed according to IZ-INRA (2001) standards for a weight gain of 700 g/day. From the age of 6 to 11 months and from 12 to 13 months, the animals in the experimental group (E) were given rations with two different energy (UFL) and protein (PDI) levels that were 15% lower or 15% higher in successive feeding periods, respectively, in relation to group C. From 14 months of age to 100 days of lactation, all of the animals were fed equally according to IZ-INRA (2001) standards. Before the expected parturition (15-7 days), 10 heifers (5 per group) underwent ultrasound testing of parenchyma in the front right quarter of the udder to determine the content of secretory and adipose tissue, following a procedure developed by Strzetelski et al. (2004).

Milk performance was determined based on the maximum production (PM) obtained during the first 100 days of lactation and total milk yield. Milk output was measured using TRU-TEST milk meters. Proximate chemical analysis of the feeds was carried out according to AOAC (1990). Statistical calculations were performed by one-way variance analysis, using the GLM procedure of the SAS statistical package (1989).

RESULTS

From 6 to 11 months of age heifers of group E were given rations with lower energy and protein contents compared with the control group (C) and achieved significantly lower ($P < 0.01$) daily body gains and body weight at 11 months of age (Table 1).

The increased feeding level of group E heifers between 12 and 13 months of age resulted in a more intensive growth rate ($P \leq 0.01$) than the animals in group C and in compensation of their body weight in the successive growth period. Feeding heifers according to the stair-step system did not result in lowering reproductive indices.

No statistically significant ($P > 0.05$) differences were found between the groups in milk yield or in percentage of secretory and adipose tissue in the udder

($P > 0.05$) due to high individual variability (Table 2). However, there was a tendency towards increased milk production and percentage of secretory tissue in the udder and a tendency towards a decreased percentage of adipose tissue in the udder of pregnant heifers in group E.

Table 1. Body weight, daily gains and reproductive parameters of heifers

	Groups		RMSE ²
	control	experimental	
Body weight at month of age, kg			
6	178.5	182.2	22.1
11	279.7 ^a	258.3 ^b	21.5
13	321.8 ^a	311.3 ^b	16.8
18	416.7	412.8	17.6
before calving ¹	599.8	610.6	15.7
Daily weight gain at months of age, g			
6 - 11	667.5 ^A	502.7 ^B	37.4
12 - 13	689.2 ^A	866.5 ^B	33.9
14 - 18	642.3	687.2	41.7
19 - calving	645.5	702.3	60.1
Age of heifers at calving, months	27.5	27.4	0.52
Insemination index	1.87	1.63	0.84
Conception rate, %	59.0	50.0	-

¹ day 7, ² $\sqrt{S^2}$, ^{A,B} - $P \leq 0.01$, ^{a,b} - $P \leq 0.05$

Table 2. Percentage of secretory and adipose tissue in udder of pregnant heifers and milk yield of primiparous cows

	Groups		RMSE
	control	experimental	
Secretory tissue, %	29.09	43.23	12.35
Adipose tissue, %	70.91	56.77	14.33
Milk yield during the first 100 days lactation, kg	2554.8	2701.5	219.7
Maximum milk output (PM), kg/day	28.9	30.5	2.67

DISCUSSION

The growth indices obtained in this experiment are close to the standards recommended for heifers by Hoffman (1997). The reproduction indices obtained for animals of groups C and E indicate that the stair-step feeding system in the period before and after puberty does not adversely affect reproductive performance of heifers.

The slightly better production indices and a higher percentage of secretory and lower share of udder tissue of the experimental group compared with the control group point to a beneficial effect of a simplified stair-step feeding system (Chandler, 1994)

on the analysed parameters. A beneficial effect of the traditional stair-step system in the period from 6 to 24-25 months of age on productive results and chemical composition of the mammary gland parenchyma in HF heifers was also reported by Choi et al. (1997). These authors consider that a diversified feeding level stimulates compensatory growth, which is accompanied by better development of the udder secretory tissue and higher milk yield during lactation than with standard feeding.

CONCLUSIONS

A diversified stair-step feeding regimen of Red-and-White × Holstein-Friesian heifers from 6 to 13 months of age in relation to IZ-INRA (2001) standards for a daily gain of 700 g/day results in a favourable milk yield during the first lactation and an improved proportion of secretory tissue in the udder.

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STRESZCZENIE

Wpływ uproszczonego systemu żywienia „stair-step” na produktywność jałówek rasy cz.b. × h.f.

Osiemnaście jałówek rasy cz.b. × h.f. przydzielono do 2 analogicznych grup (po 9), w których od 6 do 11 (1.okres) i od 12 do 13 (2. okres) miesiąca życia stosowano dwa różne poziomy żywienia: w grupie kontrolnej (C) zalecany przez normy IZ-INRA dla przyrostu 700 g/dzień, a w grupie doświadczalnej (E) w systemie „stair-step”, niższy o 15% w 1. okresie i wyższy o 15% w 2. okresie w porównaniu z grupą C. Od 14 miesiąca życia do 100 dnia laktacji obydwie grupy żywiono wg systemu IZ-INRA. Stwierdzono, że zróżnicowany („stair-step”) poziom żywienia jałówek przed i po uzyskaniu dojrzałości płciowej wpłynął korzystnie na wydajność mleczną i zawartość tkanki wydzielniczej w wymieniu.