Win-win for dairy farms: Heifers raised on pasture reduce cost and produce more milk at first lactation

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Abstract. Pastures under good management promote environmental, economic, and animal welfare advantages. However, comparisons of animal performance for pasture-raised dairy heifers versus confinement-raised dairy heifers are scarce. A study was conducted to evaluate the performance of dairy heifers raised on pasture or in confinement. Heifers raised on pasture had similar body weight and age at calving and greater dry matter intake in the end of 2nd grazing season. Cost of heifers raised on pasture was 26.7% less in the first grazing season and 58.4% less in the second grazing season compared to heifers raised in confinement. Heifers raised on pasture had greater dry matter intake and milk yield through first lactation. Physiological adaptation and nutritional benefits are involved in those benefits through lactation. Mammary gland development before breeding and increased feed intake before calving might be the main drivers for the advantages found for heifers raised on pasture compared to heifers raised in confinement. However, further studies are needed to evaluate nutritional and physiological differences of heifers raised on pasture compared to heifers raised in confinement.

Introduction

Raising replacement heifers represents the second greatest expense on the dairy farm (Hawkins et al., 2020). Feeding regimens should be carefully established to provide a satisfactory growth rate for dairy heifers, achieving about 60% and 90% of mature body weight at breeding (13 to 15 months old) and at first calving ages (22 to 24.5 months old), respectively, to maximize milk production (Troccon, 1993; Van Amburgh *et al*., 1998; 2019). In addition to those targets, other important objectives would include reducing environmental impacts and optimizing animal welfare (Heinrichs *et al.*, 2017).

Pasture establishment provides opportunity for dairy farms to be more environmentally friendly by reducing sediment erosion, water contamination, and increasing C sequestration and retention in the soil (Rotz *et al.*, 2009). With regard to animal welfare, pasture decreases lameness occurrence risk, and cows spend more time eating and lying (Arnott *et al.*, 2017; Hernandez-Mendo *et al.*, 2007; Olmos *et al.*, 2009). Furthermore, heifers raised on pasture results in lower overall cost compared to heifers raised in confinement (Hawkins *et al.*, 2020).

Focusing on understanding the impacts of heifer rearing strategy on the first-lactation performance of dairy cows, Camisa Nova *et al.* (2022) performed a study comparing Holstein heifers raised in an intensive-managed pasture with heifers raised in confinement from 4 months old through the first calving. Milk production and composition, dry matter intake, feed efficiency and body weight in the first- lactation were evaluated for potential carryover effects in consequence of heifer rearing strategy. In this trial, age at first calving for heifers reared on pasture and in barns was similar (24.4 vs 24.2 ± 0.46 mo, respectively).

Heifer growth through first calving on pasture and in confinement

In this experiment (Camisa Nova *et al.*, 2022), heifer-raising management can be defined by three distinctive periods: first-year grazing, winter confinement and second-year grazing seasons (Fig. 1). Those periods were set based on the forage mass on pasture. First grazing season started in May and ended in October, which was followed by the winter season where all heifers were kept in confinement in a free-stall barn. At the start of the second season, heifers previously raised on pasture in the first grazing season were returned to the pastures from the second half of May to September, when they started the prepartum management based on the expected calving date. Heifer performance was assessed at the beginning and at the end of each period (Table 1).

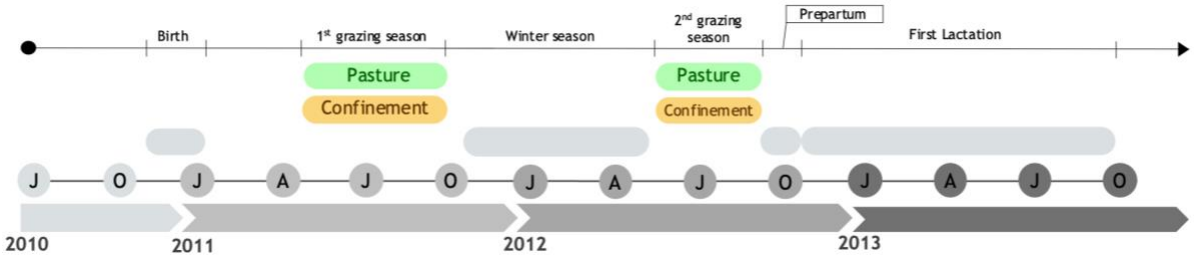

Figure 1: Trail timeline and treatment arrangements for dairy heifers.

Heifer performance during the first grazing season

In the first grazing season, confinement-housed heifers presented greater dry matter intake, resulting in greater average daily gains compared to heifers raised on pasture (Table 1). This was likely due to greater energy content of the confinement diet compared to the pasture diet. Heifers on pasture received supplementation to provide additional energy so that growth would be similar between the two treatments.

Table 1: Average daily gain and dry matter intake of heifers during the growth phase.

Item	1st grazing season		Winter		2nd grazing season	
	Pasture	Confinement	Pasture	Confinement	Pasture	Confinement
iBW	167.3	167.4	304.3	324.3**	483.1	488.5
fBW	304.3	324.3**	483.1	488.5	594.2	614.6
ADG	0.820	0.930**	0.970	0.900	0.66	0.75
iBCS	2.78	2.75	3.01	3.14	3.30	3.40
fBCS	3.01	3.14	3.30	3.40	3.90	4.00
ΔBCS/mo	0.07	0.04	0.05	0.04	0.10	0.12
iDMI	5.78	4.95*	-	-	12.79	9.09***
fDMI	6.28	7.43***	-	-	24.4	24.2***

* $0.05 < P \leq 0.10$; ** $0.01 < P \leq 0.05$; *** $P \leq 0.01$. iBW = initial body weight; fBW = final body weight; ADG = average daily gain; iBCS = initial body condition score; fBCS = final body condition score; iDMI = initial dry matter intake; fDMI = final dry matter intake.

Previous research argued that excessive prepubertal ADG (over 799 g/d; (Heinrichs *et al.*, 2017; Zanton and Heinrichs, 2005) causes a negative effect on mammary gland development because excessive energy alters secretion of growth hormone which drives mammary parenchyma tissue synthesis (Sejrsen *et al.*, 1982; 1983). Although the average daily gain of heifers raised on pasture was greater than the recommendation by Zanton and Heinrichs (2005), it could be less impactful that the ADG for heifers raised in confinement. As a result, dairy heifers raised on pasture before puberty may help control energy intake avoiding excessive weight gain, and consequently, without compromising mammary gland development.

Heifer performance during the winter

In the winter season, heifers were confined and fed with the same diet formulation (TMR). This resulted in a compensatory weight gain for pasture-raised heifers such that they had the same body weight of confinement-raised heifers at the start of the second grazing season (Table 1). Unfortunately, feed intake in the winter season was not recorded, which could have partially explained the compensatory growth. Based on these results for the winter, we might conclude that the housed period during the winter for heifers is important to enhance ADG of heifers raised on pasture to reach the recommended age and body weight at calving.

Heifer performance during the second grazing season

During the second grazing season, the only differences between the two feeding regimens were for dry matter intake. A common feeding management for dairy heifer in the US is restricted feeding. This strategy is popular because feed efficiency impacts the feed cost to raise dairy heifers in barns. Also, overweight risk is reduced, and milk production is not compromised (Zanton and Heinrichs, 2007). On the other hand, pregnant heifers on pasture did not become overweight because high forage intake is associated with lower energy intake. Rumen capacity and/or volume could be positively affected by the free access for pasture before prepartum, which could reflect in greater DMI of heifers raised on pasture through first lactation.

Feed cost of heifers raised on pasture or in confinement

For the first grazing season, the feed cost for pasture-raised heifers was calculated to be US$142.47, and for confinement-reared heifers was US$194.48 for the season. This represents 26.7% less cost when heifers were raised on pasture compared to those raised in confinement. During the second grazing season, the cost for heifers raised on pasture was even less compared to those raised in confinement. Heifer feed cost on pasture during the second grazing season was US$97.43, which is 58.4% less than the cost for heifers raised in confinement (US$234.18). The greater difference in feed cost in the second than in the first grazing season is because there was no concentrate intake for heifers on pasture. This substantially reduces diet expenses compared to heifers raised in confinement.

First lactation performance of heifers raised on pasture or in confinement

After calving, all cows were fed and managed equally regardless the heifer rearing strategy they were submitted previously. Milk production and composition, feed intake, and body weight were recorded at 50, 100, 150, and 200 days in milk. Heifers reared on pasture resulted in greater milk yield, DMI, and MUN compared to heifers raised in confinement. Milk fat, protein, lactose, body weight, and feed efficiency were not different between the groups (Table 2). In the end of the first lactation, total milk production was greater for heifers reared on pasture than in confinement (12,337 vs 11,107 kg, respectively). Also, pasture-reared heifers performed better for total protein yield than confinement-raised heifers (437 vs 358 kg, respectively). Greater dry matter intake through first lactation was one of the main factors resulting in enhanced milk production of heifers raised on pasture.

Final considerations and future directions

The study presented by Camisa Nova *et al*. (2022) brought many questions and insights for future studies regarding raising heifers on pasture. Management practices adopted in regions with temperate climates for heifers raised on pasture might be associated many physiological and nutritional advantages as described in this review. Further research investigating physiological adaptations of heifers raised on pasture is needed to clarify why performance of heifers in the first lactation is greater, and further determine if this advantage persists through subsequent lactations.

Table 2: First lactation performance of grazing-reared heifers and confinement-reared heifers

Variable	Days in milk (days)							
	50		100		150		200	
	Grazing	Conf.	Grazing	Conf.	Grazing	Conf.	Grazing	Conf.
Milk yield (kg)***	43.0	39.2	43.1	38.6	42.3	37.4	41.1	34.2
Butterfat (%)	4.15	4.12	3.94	4.06	3.77	3.86	3.99	3.97
Protein (%)	2.78	2.80	2.87	2.92	2.99	3.05	3.02	3.07
Lactose (%)	5.10	5.14	5.03	5.03	5.02	5.00	4.96	4.92
Milk urea nitrogen (mg/dL)**	10.91	9.48	12.64	11.51	12.86	11.88	13.84	12.82
Dry matter intake (kg)**	24.3	22.4	25.6	24.9	26.4	25.3	25.9	24.1
Feed efficiency (ECM/kg DMI)	1.77	1.75	1.69	1.56	1.60	1.48	1.59	1.43
Body weight (kg)	570.10	573.22	578.01	585.07	600.64	604.70	614.75	626.82

* $0.05 < P \leq 0.10$; ** $0.01 < P \leq 0.05$; *** $P \leq 0.01$.

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