



Simplified Management of Dairy Heifers: Different Protein Supplements in Spineless Cactus Based Diets



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Abstract

The aim of this study was to establish a simplified management for rearing dairy heifers evaluating different protein supplements in spineless cactus based diets. Twenty-five Girolando heifers were used in feedlot, with initial body weight of 227 ± 72 kg, assigned to a randomized block design. Five protein supplements (wheat bran, soybean meal, cottonseed meal, and whole cottonseed) were compared to the control diet (without supplement). The cottonseed meal provided higher intake of DM (8.19kg/d), and digestible OM (4.63kg/d). There were no effects of protein supplements on digestibility of DM, OM, CP and NFC. The cottonseed meal provided higher digestibility of NDF (465g/kg). Weight gain and feed conversion were not affected in animals supplemented with whole cottonseed (750g/d and 9.1), cottonseed meal (840g/d and 9.75) and soybean meal (720g/d and 10.78). Therefore, the establishment of a simplified management using any of the studied protein supplements should occur depending on the availability and price of the product in the region.

Keywords: Crossbred; Supplementation; Feeding management; Performance

Abbreviations: DM: Dry Matter Basis; BW: Body Weight; IADF: Indigestible Acid Detergent Fiber; OM: Organic Matter; MM: Mineral Matter; CP: Crude Protein; EE: Ether Extract; NDF: Neutral Detergent Fiber; ADF: Acid Detergent Fiber; NFC: Non-Fiber Carbohydrate; N: Nitrogen; RUP: Rumen Undegradable Protein; ADG: Average Daily Gain; FC: Feed Conversion

Introduction

The establishment of an efficient rearing system, especially of females, has been a challenge for most dairy farmers due to the lack of planning and the lack of proper food handling. Poor management has led to late age at first calving, reduction in the number of dairy cows, low productivity of the herd and female life cycle.

Malnutrition of dairy heifers results in reduced growth and declining age at first mating, whereas overfeeding (excess of protein) can result in reproductive failure. Thus, the nutritional plan to be adopted should be the most simplified and economical for the producer, allowing to quickly reach the age to mating.

Studies in the literature have demonstrated the importance of the spineless cactus to dairy animals feeding [1,2], for its high content of non-fibrous carbohydrates (640-710g/kg), supplying virtually the entire energy requirement of the animal. Due to reduced protein content (481g/kg) [2], diets containing spineless cactus need to be supplemented with protein sources. The combination of a single supplemental source to the diet,

compared to a balanced commercial concentrate, would facilitate the feeding management reducing costs with the rearing stage.

Therefore, it was aimed to establish a simplified feed management for rearing dairy heifers, assessing the effects of different protein supplements in spineless cactus-based diets on intake, digestibility of nutrients and performance.

Materials and Methods

All procedures performed in studies involving animals were in accordance with the ethical standards of Ethics Committee on Animal Use of the Federal Rural University of Pernambuco or practice at which the studies were conducted.

The experiment was conducted at the Agronomic Institute of Pernambuco - IPA, in Arcoverde-PE, Brazil. Twenty-five dairy heifers of Girolando breed, with an average initial body weight of 227 ± 72 kg and 12 months of age were distributed in a randomized block design and kept in individual stalls equipped with drinking and feeding troughs. The experiment lasted 84 days, divided into three periods of 28 days each.

The control diet (without protein supplement) was composed of 64% spineless cactus (*Opuntia ficusindica Mill cv. Gigante*), 30% sugarcane bagasse in natura, 4% urea: ammonium sulfate mixture (9:1) and 2% mineral mixture, on a dry matter basis (DM). The other treatments consisted of different protein supplements (wheat bran, soybean meal, cotton seed meal or whole cottonseed) provided on the basis of body weight

(0.5% BW) (Table 1). The spineless cactus was cut directly in the field, being subsequently chopped in forage machine. The urea and ammonium sulfate were mixed with the concentrate ingredients in grain mixer. The mixture of ingredients (spineless cactus+sugarcane bagasse+ supplement) was performed manually.

Table 1: Chemical composition of control diet and ingredients used in the protein supplements.

	Chemical Composition							
	DM ¹	OM ²	CP ²	EE ²	NDFap ²	NFC ²	ADF ²	Lignin ²
Control diet	137	885	134	20.5	428	239	340	74.7
Spineless cactus	106	875	39.9	23.5	287	524	225	52.3
Sugarcane bagasse	257	949	16.7	18.3	812	102	652	139
Wheat bran	883	941	166	40.2	423	312	154	42.3
Whole cottonseed	870	960	217	211	451	80.7	420	74.7
Cottonseed meal	873	933	397	9.1	323	204	268	29.1
Soybean meal	852	923	485	19.4	100	318	123	17.6

DM: Dry Matter; OM: Organic Matter; CP: Crude Protein; EE: Ether Extract; NDFap: Neutral Detergent Fiber Corrected for Ash and Protein; NFC: Non-Fiber Carbohydrates; ADF: Acid Detergent Fiber 1g/kgas fed, 2g/kgdry matter.

The diets were offered twice daily (50% at 8h and 50% at 16h), allowing leftovers of 10% of the DM provided. The quantities of supplied feed and leftovers of each animal were recorded daily to estimate the intake.

To calculate the apparent nutrient digestibility, the fecal dry matter production was estimated using the indigestible acid detergent fiber (iADF) as an internal marker [3]. Dried feed, leftovers and fecal samples were analyzed for dry matter (DM), organic matter (OM), mineral matter (MM), crude protein (CP), and ether extract (EE) according to methodologies described by AOAC (2005). Neutral detergent fiber (NDF) and acid detergent fiber (ADF) were determined according Van Soest et al. [4]; and non-fiber carbohydrate (NFC) was determined according to Hall [5].

Data were subjected to analysis of variance and the Student-Newman-Keuls (SNK) test, adopting the significance level of 5%, using the statistical package Statistical Analysis System-SAS.

Results

The cottonseed meal provided higher intake ($P<0.05$) of DM (8.19kg/d) and digestible OM (4.63kg/d) (Table 2). Heifers supplemented with cottonseed meal and soybean meal showed higher CP intake (1.38kg/d). There was no effect ($P>0.05$) of the protein supplements on the DM, OM, CP and NFC digestibility, with average values of 609; 631; 779 and 829g/kg of DM, respectively (Table 2). The cottonseed meal provided higher ($P<0.05$) digestibility of NDF (465g/kg). Weight gain and feed conversion were not affected ($P>0.05$) in heifers supplemented with cottonseed meal (840g/d and 9.75), whole cottonseed (750g/d and 9.1) and soybean meal (720g/d and 10.78) (Table 2).

Table 2: Intake, digestibility and performance of Girolando heifers fed control diet (without protein supplement) and protein supplements.

Item	Control diet	Wheat bran	Whole cottonseed	Cottonseed meal	Soybean meal	SEM
Intake (kg/d)						
DM	6.28c	7.08abc	6.83bc	8.19a	7.71ab	0.15
OM	5.42b	6.17ab	5.96ab	7.20a	6.74a	0.139
CP	0.90b	1.03b	1.03b	1.38a	1.38a	0.019
NDF	2.48	2.84	2.69	3.29	2.77	0.077
NFC	1.89b	2.12ab	1.91b	2.36a	2.41a	0.043
DOM	3.38b	3.95ab	3.63ab	4.63a	4.30ab	0.109

Digestibility (g/kg)						
DM	600	608	599	630	615	6.226
OM	623	640	609	644	637	7.691
CP	779	779	752	785	799	5.295
NDF	448a	388b	356b	465a	385b	5.144
NFC	790	840	850	840	825	15.584
Performance						
ADG (g/d)	430b	590ab	750a	840a	720a	0.029
FC	15.9a	12.2ab	9.10b	9.75b	10.8b	0.559

DM: Dry Matter; OM: Organic matter; CP: Crude Protein; EE: Ether Extract; NDFap: Neutral Detergent Fiber Corrected for Ash and Protein; NFC: Non-Fiber Carbohydrates; ADG: Average Daily Gain; FC: Feed Conversion; SEM: Standard Error of the Mean Means followed by different letters in the same row differ by test SNK ($P < 0.05$).

Discussion

Providing of true protein and supplemental energy can increase dry matter intake due to the adequacy in the supply of nutrients to the rumen microorganisms. The higher intake of DM and energy (digestible OM) in heifers supplemented with cottonseed meal, combined with higher digestibility of NDF, reflected in superior performance (840g/d) compared to heifers fed with the control diet. For heifers supplemented with cottonseed meal and soybean meal, the highest intake of CP reflected in greater weight gain (840 and 720g/d). The best performance with the supply of protein sources is justified by the improvement of the metabolizable protein flow to the small intestine.

In the control diet, 77% of total N was derived from the urea because the spineless cactus and the sugarcane bagasse provide reduced CP, and in the sugarcane bagasse the protein is almost completely unavailable. Thus, it appears that the protein supplementation for rearing heifers would allow gains of over 50% compared to non-supplemented animals (430g/d).

As cottonseed meal consists of a better source of RUP than soybean meal (43 vs. 35% RUP) [6], it is justified the numerical difference of 120 g observed for the average daily gain. According to Broderick et al. [7], the high content of RUP of cottonseed meal provides amino acids for the ruminant via absorption of the small intestine, allowing higher performance. Wanapat et al. [8] found better amino acid balance in cows fed with diet containing cottonseed meal.

Supplementation with cottonseed meal in diets with spineless cactus on the basis of 0.5% of body weight allows a more simplified management for the farm producer, resulting in daily gains that allow achieving body weight to mating at 16

months of age, with heifers being inseminated with 340kg body weight. This result allows the occurrence of the first calving at 25 months of age.

With the control diet, wheat bran, whole cottonseed and soybean meal supplements, the body weight to mating would be reached at 21,18,17 and 17 months in dairy heifers, respectively; resulting in an age of 30, 27, 26 and 26 months for the first calving. It is noteworthy that in Brazil the age at first calving varies between 36 and 40 months. According to Moreira [9], the lower the age at first calving, the greater the daily milk yield and the property income [10].

Conclusion

Therefore, the establishment of a simplified management using any of the studied protein supplements should occur depending on the availability and price of the product in the region and targets regarding age at first calving of the heifers.

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