Early weaning promotes improvement of blood nutritional indicators in half-bred zebu cows

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Abstract

Blood nutritional indicators were measured in half-bred zebu cows that suckled their calves throughout lactation (control; n=30) or until 60 to 75 days when their calves were weaned (EW: n=30). Measurements of live weight, evaluation of body condition score (BCS), and blood collection began on day 0 (=date calves from EW cows were weaned) and then on days 7, 14, 21, 30, 60 and 90. At the end of 90 days, BCS and live weight were significantly higher in EW than in the control cows (5.4±1.0 and 407±42.5 kg versus 4.0±0.9 and 388±39.1 kg). EW had higher blood concentration ($p < 0.05$) of albumin (3.43±0.22 versus 2.92±0.11 g/dl), urea (0.37±0.09 versus 0.19±0.06 g/l), hemoglobin (13.5±0.44 versus 11.4±0.37 g/dl), iron (98.8±21.5 versus 74.7±11.8 µg/dl) and copper (60.3±8.8 versus 47.7±9.2 µg/dl). Serum glucose levels did not differ between the two groups. Treatment effects on live weight, BCS and blood hemoglobin were significant after day 30, and on the remaining serum nutritional indicators after day 21.

In line with expectations, cows whose calves were weaned early showed superior nutritional status compared with those that continued to suckle their calves.

Keywords: *Zebu, half-breds, early weaning, live weight, body condition score, blood nutritional indicators*

Introduction

The late onset of ovarian activity in mature cattle raised under tropical conditions is the major factor impeding a sound reproductive performance needed for the increasing demand for livestock products. The effect of suckling has been identified as one of the most important factors impeding ovarian activity. Early weaning of the calves is one management tool used by farmers to overcome the suckling effect without compromising reproduction, nor health of the calves (Galina et al 2001).

Early weaning (EW), in the beef cattle breeding extensive system, is the abrupt separation between the cow and its calf at between 60 and 75 days old, provided the latter is not less than 70 kg in live weight. In contrast, late weaning (LW) is carried out at 6 to 8 months, when the calves are between 140 and 160 kg (Galli et al 1995). Early weaning is a management practice which tends to improve the reproductive performance, generating larger forage availability for the cow, because nursing is suppressed and the calves receive artificial feeding (Arias et al 1996). Calving intervals are decreased significantly with increasing body condition score (Obese et al 1999). Higher pregnancy rates were observed in cows approaching or maintaining average body condition from parturition to conception than for cows moving away from moderate body condition (Houghton et al 1990). Females that nursed generally were heavier, were taller, and had higher condition scores at most ages than early-weaned females, but early-weaned females were favored over females reared by their dams in percentage of calves produced per cow exposed (Gregory and Maurer 1991).

As a disadvantage, it is reported that early weaning produces a great stress (Galli et al 1995). The response to stress separation by both cows and calves increased when calves were separated at later rather than earlier ages; also, calves separated at the later age gained more live weight (Arias et al 1996, Flower and Weary 2001). Catecholamine concentration in dams increased in response to stress associated with weaning (Lefcourt and Elsasser 1995). In late weaning, cows made significantly more movements in the pen, called at much higher rates, spent more time standing and spent more time with the head out of the pen, than cows separated soon after birth (Weary and Chua 2000).

Interactions between under-nutrition and weaning effects on the duration of post-partum anoestrus and associated variation in milk yield, suckling behavior and metabolic hormone levels, were verified in half-bred zebu cows. Low body condition score (BCS) at calving (3.5 ± 0.1, scale 1-9) was associated with prolonged post-partum anoestrous intervals in suckled cows, but provided cows were maintaining liveweight, ovarian cyclicity resumed within 50 days if calves were weaned 70 days post-partum (Jolly et al 1996).

According to Slobodianik et al (1999), biochemical methods provide an objective means of assessing nutritional status and can be used with other methods enabling specific or global nutritional problems to be identified.

The objective of the present study was to relate nutritional indicators in blood with changes in body weight of half-bred zebu cattle, induced by early versus late weaning.

Materials and methods

Experimental design

A repeated measure design was used, considering the treatment (early weaning versus continued suckling) and the time (growth) as independent variables, and the blood hemoglobin and serum albumin, urea, glucose, iron and copper concentrations, as well as the weight and body condition score (BCS), as dependent variables. The measurements were made on seven occasions during the three months of the study, in late spring and early summer.

Animals and location

Sixty suckled non-pregnant half-bred zebu cows (third calf, 4-5 years old and 360 kg mean live weight), clinically healthy and phenotypically homogeneous, were used. They were randomly divided into early weaning (EW) and control (C) groups of thirty animals each. The groups stayed in contiguous plots with similar pasture. The control cows continued to suckle their calves throughout the study, while those in EW were weaned when their calves were from 60 to 75 days old (60 to 90 kg live weight).

The study was carried out on a farm in northeast Argentina, in a subtropical climate area with 1200 mm of rain annually and with natural pastures of perennial grasses with 6% of crude protein in the summer. The region is dedicated to extensive breeding of beef cattle, and the calves are usually weaned in summer, at approximately 6-8 months old.

Sample collection

Weighing, BCS evaluation (scale 1-9), and collection of samples began for both groups when the calves were weaned in treatment EW (day 0) and then 7, 14, 21, 30, 60 and 90 days later. Pregnancy rate of the cows from both groups was detected by means of rectal palpation. The live weight of the female calves in both treatments was recorded until the third month after the weaning of the control group. The blood samples were taken by jugular vein puncture with (or without) anticoagulant (EDTA), at 07.00 to 08.00 h each morning. The clotted blood was centrifuged (700g, 10 min) to obtain the serum, which was kept at 4ºC until assayed within 6 hours of extraction.

Assay procedures

Concentrations of serum albumin (bromide-cresol-sulphophthalein method, 625 nm, Wiener reagents), urea (urease technique, 546 nm, GT-Lab reagents), glucose (oxidase technique, 505 nm, Wiener reagents), iron (PBTS procedure, 560 nm, Wiener reagents), copper (batocuproin method, 436 nm, Boehringer reagents), and blood hemoglobin (cyanmethaemoglobin technique, 540 nm, Wiener reagents), were measured at 37ºC in a Labora Mannheim 4010 photometer.

Statistical methods

The normality of the distribution of the obtained values was assessed using the Wilk-Shapiro (WS) test. Parametric descriptive statistics (mean x, standard deviation SD and confidence interval CI±95%) were calculated by conventional procedures; correlation coefficients (r) were obtained by the Pearson procedure. Analysis of variance (ANOVA) for repeated measures was calculated, including the significance of the time and treatment effects. Following the ANOVA, the significance of differences between groups Control and EW on each day was estimated by orthogonal contrasts. All the calculations were made using the software Statistica, Version 1999. Statistical significance in this paper refers to the 5% level ($p < 0.05$).

Results and discussion

Initial and final values are shown in Table 1. Initial values were homogeneous in both Control and EW groups (CI ± 95%), and they revealed normal distribution, inserting in the reference interval described for the geographical area, breed and age of studied cattle (Coppo 2001b). No significant treatment x time interactions were registered by the repeated measures ANOVA analysis.

Table 1. Control (C) and experimental (E) cows obtained values

Parameter	Initial values (day 0)		Final values (day 90)	
	Control (n = 30)	**EW (n = 30)**	**Control (n = 30)**	**EW (n = 30)**
Live weight (kg)	364 ± 38.5 a	359 ± 35.7 a	388 ± 39.1 b	407 ± 42.5 c
BCS (scale 1-9)	3.7 ± 0.9 a	3.6 ± 0.8 a	4.0 ± 0.9 a	5.4 ± 1.0 b
Albumin (g/dl)	3.12 ± 0.15 a	3.18 ± 0.13 a	2.92 ± 0.11 b	3.43 ± 0.22 c
Urea (g/l)	0.27 ± 0.05 a	0.29 ± 0.07 a	0.19 ± 0.06 b	0.37 ± 0.09 c
Glucose (g/l)	0.59 ± 0.12 a	0.62 ± 0.13 a	0.61 ± 0.10 a	0.57 ± 0.12 a

Hemoglobin (g/dl)	11.2 ± 0.39 a	11.7 ± 0.41 a	11.4 ± 0.37 a	13.5 ± 0.44 b
Iron (µg/dl)	75.3 ± 12.6 a	78.1 ± 14.3 a	74.7 ± 11.8 a	98.8 ± 21.5 b
Copper (µg/dl)	62.4 ± 8.6 a	58.6 ± 7.4 a	47.7 ± 9.2 b	60.3 ± 8.8 a

Values expressed in x ± SD. BCS: body condition score. In each line, different letters indicate significant differences between mean groups (p < 0.05).

Live weight increased in both treatment groups, with EW animals gaining more weight (526 g/day) than the controls (235 g/day) (Figure 1). Differences between Control and EW groups began to be significant from day 30. These differences due to early weaning are similar to those reported by Arias et al (1996), who obtained gains of 343 g/day (EW) versus 222 g/day (Control) in a 120 day trial, and by Sciotti et al (1996) (432 g/day for EW versus 126 g/day (Control) in first calving half-bred zebu cows).

Trends for BCS were similar to those for liveweight and agree with observations in northeast Argentina (Arias et al 1996), in a trial which was initiated with BCS = 3.8 and finished with 6.2 (EW) versus 4.2 (Control). Turinetto (1993) recorded a final BCS of 4.5 for EW versus 3.0 for the control in zebu cows, while Hidalgo et al (1996) reported 3.8 for EW versus 3.5 (Control) in Aberdeen Angus cattle.

In EW cows there were linear associations between live weight and increments of BCS (r = 0.98, p = 0.05), albumin (r = 0.90, p = 0.006), urea (r = 0.92, p = 0.001), hemoglobin (r = 0.89, p = 0.02) and iron (r = 0.92, p = 0.005).

Figure 1. Evolution of live weight in Control and EW cows

Differences in concentration of serum albumin between Control and EW were significant from day 21 (Figure 2).

Figure 2. Evolution of serum albumin in control and experimental (EW) cows

Serum albumin is a very sensitive and early nutritional indicator of protein status according to Slobodianik et al (1999), because its plasma mean life (turnover) is only 16 days. Albumin is a major storage reservoir of proteins and transporter of amino acids (Kaneko 1989). Albumin hepatic synthesis is influenced by the state of nutrition and diminishes during malnutrition (Jain 1993). .

Serum urea concentration changed in the same way as serum albumin concentration. Serum urea is a nutritional indicator of the nitrogen balance (Slobodianik et al 1999); its concentration in blood rises when nitrogen availability increases and vice versa (Coppo 2001b).

Serum glucose concentration were not affected by early weaning nor were there changes in time, with values being similar at the start and end of the trial. In normal physiological conditions, propionate is the most important precursor of glucose in cattle, but this situation changes in malnutrition induced by excessive glucose requirement, when glycerol becomes the main glucose precursor (Cirio and Tebot 2000). In the present trial, the cows in both treatments gained in live weight and body condition which implies that gluconeogenesis from propionate, or from glycerol originating from fat mobilization (Kaneko 1989; Coppo 1990), was sufficient to maintain blood glucose at normal levels in both early and late weaned (control) cows..

Blood hemoglobin concentration increased in EW but not in Control cows, with significant differences apparent after day 30. Decrease in hemoglobin indicates lack of amino acids, vitamins (B12, E, folic acid, niacin) and/or minerals (Cu, Co, Fe, Se) (Kaneko 1989; Jain 1993).

Serum iron concentrations increased in the EW cows and were unchanged with time in the Control animals, with the differences being observed as from the first week following early weaning. Although iron concentration is not very high in cow's milk (Gómez Piquer 1992), this mineral flows with the milk for calf hemoglobin synthesis (Coppo et al 1990).

Differences between Control and EW cows plasma copper values were significant from day 7 (Figure 3).

Figure 3. Evolution of serum copper in control and experimental (EW) cows

Serum copper concentration is a nutritional indicator of the balance between the copper input and output (Slobodianik et al 1999). Northeastern Argentine pastures have been shown to be deficient in copper (Coppo 1982). Milk mobilizes copper towards the calf, although this mineral is not very abundant in cow milk (Coppo 2001b).

At the end of the trial period, the female calves that had been weaned early showed a smaller weight gain (513 g/day) than those weaned at the traditional; time (666 g/day). However, 90 days later these differences were no longer apparent, thus both groups arrived at the age of first mating (2 years old) with similar body weights, with the implication that the early weaning practice had no influence on reproductive performance.

Conclusions

The results of the present study confirm that blood hemoglobin and serum concentrations of albumin, urea, iron and copper are indicative of differing nutritional status in beef cows caused by early weaning of the calves. In contrast, serum glucose was not affected and thus appears to be much less sensitive to nutritional status.

Management of post-partum anoestrus in half-bred zebu cows should focus on the strategic use of early weaning procedures and / or ways to maintain / improve the body condition.

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