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Physiological and behavioural responses of cows from two beef breeds submitted to different suckling strategies

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ABSTRACT

This experiment was designed to study the effects of avoiding calf contact and genotype on the metabolic, behavioural and reproductive traits of beef cows during lactation. Fifty-two multiparous cows, 25 Parda de Montaña (PA) and 27 Pirenaica (PI), fed at maintenance were assigned from the day after calving to twice-daily nursing (2× 30-min sessions at 0800 and 1600 h) either with fence contact with their calves (partial contact, PC) or without visual, tactile and olfactory contact (non-contact, NC) between suckling periods. Blood samples were collected to analyse metabolites (triglycerides, cholesterol, non-esterified fatty acids (NEFA), β-hydroxybutyrate and urea) and progesterone at different intervals. Cow–calf behaviour was monitored on weeks 4, 9 and 15 of lactation. Cow activity at oestrus was recorded through collars. Cows from both treatments and breeds showed similar live-weight gains during the first three months post-partum ($P > 0.10$). Milk yield and calf gains were not affected by treatment ($P > 0.10$) but they were greater in PA than in PI ($P < 0.05$). Plasma triglycerides and urea in the cows were not affected either by calf contact, breed or week post-partum ($P > 0.10$). Plasma cholesterol increased from week 6 post-partum onwards in PA cows ($P < 0.05$) while this rise was delayed to week 7 of lactation in PI breed ($P < 0.05$). Plasma NEFA was greater in blood from PC–PA cows than in the rest of groups ($P < 0.05$), and these metabolites were greater on week 1 and lower on week 11 than in rest of samplings ($P < 0.05$). Plasma β-hydroxybutyrate was not affected by either calf contact or breed ($P > 0.10$), but it was greatest on weeks 1–3 than in the rest of lactation ($P < 0.05$). Cows with PC calves took less time to first contact after they entered the barn than their NC counterparts ($P < 0.05$). Dams from both contact treatments nursed their offspring and remained in close proximity for similar time within suckling periods ($P > 0.10$). PA cows devoted more time than PI ones to lick their young ($P < 0.001$). There were no differences throughout lactation in any of the studied maternal behaviours ($P > 0.10$). Calf contact and breed did not affect the interval to first post-partum ovulation or oestrus in these cows ($P > 0.10$). Under twice-daily nursing conditions, the limitation of visual, tactile and olfactory contact with calves did not trigger different maternal or reproductive traits in these breeds but only a slightly higher mobilisation of body fat substrates in Parda de Montaña compared to Pirenaica.

1. Introduction

Suckling has been proved to be a major effect delaying the resumption of post-partum luteal function in beef cows when nutrition is not a limiting factor (reviewed by Short et al., 1990; Williams, 1990; Wettemann et al., 2003). The mechanism of inhibition is regulated by the hypothalamic–pituitary–ovarian axis and appears to require the establishment of a maternal bond (Williams and Griffith, 1995), rather than the stimulation of mammary somatosensory cues (Williams et al., 2001).

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Once-daily suckling from the day after calving has shortened post-partum anoestrus compared to *ad libitum* suckling when suckler cattle are fed at maintenance on Spanish mountain areas (Álvarez-Rodríguez et al., in press), but this practice has no effect when these cattle are slightly underfed during early and mid-lactation (Álvarez-Rodríguez et al., 2009). Some authors have suggested that restricted calf access without cow–calf contact between suckling periods after day 30 post-partum is even more useful to shorten the interval to first post-partum ovulation (Stagg et al., 1998), although this benefit has been more marked in large-frame crossbred genotypes than in small-frame pure Mediterranean breeds (Marongiu et al., 2002). Nevertheless, some of the afore-mentioned studies conducting once-daily suckling showed impaired calf growth compared to continuous mother–young contact (Marongiu et al., 2002; Álvarez-Rodríguez et al., in press), being this effect overcome by restricting suckling for twice-daily periods (Sanz, 2000).

Parda de Montaña (PA) and Pirenaica (PI) are two suckler cattle breeds widely spread throughout northern Spain. The former comes from the selection for beef and mothering abilities from the old Brown Swiss, which was introduced in the country two centuries ago as a dual-purpose breed (milk-beef). The latter is an autochthonous hardy breed from the mountain area of the Spanish Pyrenees, which was utilized in the past as a triple-purpose breed (work-milk-beef) and is currently used for beef production.

Despite having relatively similar mature weight, the live-weight (LW) gains during the grazing season are different between these breeds (Casasús et al., 2002), mainly due to lower gains of suckled Brown Swiss (currently PA cows) compared to PI cows. Furthermore, milk potential and intake capacity throughout the post-partum period are greater in PA cows so that their higher milk yield can be supported (Casasús et al., 2004). In earlier studies, PA cows have been more sensitive to calf presence than their PI counterparts as far as productive and reproductive performance is concerned (Sanz et al., 2003, 2004).

In this experiment, we hypothesized that the limitation of calf contact between twice-daily suckling periods may reduce the maternal bond and advance the ovarian resumption of dams, being this benefit greater in PA than in PI breed. In addition, we aimed at studying the effects of calf contact on cow energy metabolism during lactation.

2. Materials and methods

2.1. Animals and experimental design

Fifty-two multiparous cows (aged 7.0 ± 3.4 years, mean $\pm$ standard deviation), 25 Parda de Montaña (PA) and 27 Pirenaica (PI), were selected from the winter-calving herd of 'la Garcipollera' Research Station (North-eastern Spain), 42°37′N, 0°30′W, 945 m a.s.l., average mean temperature 10.2 ± 0.2 °C and annual rainfall 1059 ± 68 mm throughout the period 1999–2006). Cows grazed on mountain pastures during early autumn (mid-pregnancy) and they were housed in late autumn (last trimester of pregnancy).

Table 1
Chemical composition of the total mixed ration used in the experiment[a].

Dry matter (DM) (g/kg)	884
Ether extract (g/kg DM)	13
Ash (g/kg DM)	70
Crude protein (g/kg DM)	89
Neutral-detergent fibre (g/kg DM)	534
Acid-detergent fibre (g/kg DM)	285
Insoluble protein in the neutral-detergent fibre (g/kg DM)	33

[a] Feedstuffs (g/kg fresh-weight basis): barley straw (470), barley grains (126), dehydrated alfalfa (100), beet molasses (80), citric pulp pellets (72), maize gluten meal (54), soybean meal (38), rape meal (38), alfalfa pellets (12) and vitamin and mineral supplement (10). Vitamin and mineral supplement contained per kg (fresh-weight basis): Ca 107 g, P 85 g, Cl 156 g, Mg 9 g, Na 102 g, S 20 g, Fe 4 g, Zn 12 g, vitamin A 12,000 IU/kg, vitamin D3 1200 IU/kg, vitamin E (α-tocopherols 91%) 53 mg/kg, and Cu 20 mg/kg.

Dams from both breeds gained LW during the autumn grazing (8 weeks). The initial and final LW on that moment was 532 ± 47 and 541 ± 49 kg in PA and 546 ± 58 and 564 ± 62 kg in PI, respectively (maternal weight plus conceptus). At housing, body condition score (BCS) was 2.54 ± 0.10 and 2.61 ± 0.16 in PA and PI, respectively (0–5 scale, Lowman et al., 1976). Indoors, cows were group-fed 10 kg (as-fed basis) of a total dry mixed ration (Table 1) during 13 weeks to meet energy and protein requirements for maintenance and pregnancy (NRC, 2000). This feeding level was planned to achieve a moderate body condition at calving (around 2.5).

The day after parturition (mean 14 February $\pm$ 16.6 days) cows were randomly assigned, within breed, to either twice-daily calf access during two 30-min sessions (0800 and 1600 h) with fence contact with their calves (partial contact, PC) or without visual, tactile and olfactory contact (non-contact, NC) between suckling periods. Calves in the PC treatment remained in groups in fenced cubicles (5 m $\times$ 5 m) adjacent to dams' resting area with no visual, tactile or auditory isolation. In this treatment, cows and calves could not introduce their heads through the fence but they could approach their snouts through it. The fence (1.5 m height) was made on steel barriers placed horizontally with a gap of 15 cm among them. Calves in the NC treatment were kept 30 m away from dam's resting area in similar conditions to their contemporaries. Cows remained housed throughout lactation in pens (one pen per treatment, 12–14 cows/each), which had a feeding area outdoors (35 m $\times$ 5 m) and a straw-bedded area indoors (20 m $\times$ 6 m). Treatments were balanced according to cow LW and BCS at calving, calf LW at birth and calf sex.

Cows after parturition were group-fed the same total mixed ration once-daily at 0900 h (13 kg for PA, 12 kg for PI, as-fed basis; Table 1). The diet met maintenance requirements for energy and protein in a 555- or 585-kg beef cow producing about 9 or 8 kg of energy-corrected milk at peak yield, in PA and PI, respectively (NRC, 2000). There were no feed refusals (or eventually negligible) throughout the experiment. Cows were supplied water and mineral supplements *ad libitum*. Calves had free access to water but did not receive any feed supplement other than milk throughout the first three months of lactation. One bull of proven fertility from the same breed was introduced into each treatment pen on week 8 post-partum (3 months