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Impact of concentrate supplementation during early lactation on the performance of grass fed, twin suckling ewes and their progeny

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ABSTRACT

The objective of this study was to investigate the impact of concentrate supplementation during early lactation on grass intake by the lactating ewe and subsequent ewe and lamb performance during the first seven wk post-partum. Fifty-four twin bearing and rearing ewes, were randomly allocated to one of three dietary treatments (n = 18) on d 7 (± two d) of lactation (experimental d zero). Dietary treatments were as follows; GO = zero-grazed grass ad libitum from d 7 to d 49 post-partum, GC = zero-grazed grass ad libitum plus 500 g fresh weight (FW) of concentrate supplementation from d 7 to d 49 post-partum, GC21 = zero-grazed grass ad libitum from d 7 to d 49 post-partum plus 500 g FW of concentrate supplementation from d 7 to d 21 post-partum. Each ewe was penned independently with her progeny on slatted flooring at 72 h post-partum with access to a straw bedded creep for lambs only. Zero-grazed grass was harvested from predominantly perennial ryegrass (*Lolium perenne*) swards daily at 0730 h and cut to a height of 3.5 cm. Grass DMI from wk two to seven of lactation was lower for GC ewes than GO ($P < 0.01$) and GC21 ($P = 0.06$) ewes. Differences in grass DMI were not reflected in total DMI ($P > 0.10$) or total OMI ($P > 0.10$) with total OMI ranging from 1.81 to 1.94 kg per ewe per d. Rumen fluid pH dropped during the first seven d of the experiment for GC and GC21 ewes ($P < 0.01$) and was lower for both these treatments compared to GO ewes at 14 d post-partum ($P < 0.01$). Ewes from GO tended to have a lower live weight than GC ewes at wk 7 of lactation ($P = 0.06$). Ewe milk yield varied with treatment at wk seven of lactation with GC ewes producing higher yields than GO and GC21 ewes ($P < 0.01$). Treatment had no effect on lamb average daily gain during the first six wk post-partum ($P > 0.10$). The results of this study show that when ewes were offered zero-grazed grass during early lactation, concentrate feeding reduced grass DMI with no improvement in milk yield until wk 7 of lactation.

1. Introduction

The young lamb is largely dependent on milk to meet its nutritional needs during early life (Morgan et al., 2006) placing nutritional stresses on the dam. Milk production and nutrient requirements of twin rearing ewes peak during wk three to four post-partum (AFRC, 1993; Cardellino and Benson, 2002), while intake potential does not peak until approximately wk six post-partum (Vulich et al., 1991). Consequently the ewe mobilises body reserves during this period of negative energy balance (Jarrige, 1989), with this stress often exasperated by a change of environment and diet immediately post-partum (Campion et al., 2016; McGovern et al., 2015a). Increasing nutrient intake and dietary change both force an adaptation of the rumen epithelium and fermentation profile (Martens et al., 2012), placing a further strain on the ewe.

In pasture based production systems, lambing date is planned to coincide with the onset of grass growth to maximise the contribution of grazed grass to the nutrient requirement of the lactating ewe (Keady et al., 2009). Deficits in grass supply are compensated for by the inclusion of comparatively more expensive concentrate feeds in the ewes diet (Finneran et al., 2010). Supplementing lactating ewes with concentrate feeds can reduce forage intake (Bocquier et al., 1987), potentially increasing costs without improving DMI due to a large substitution effect when concentrates are offered with high quality grazed grass (Gómez-Cortés et al., 2009).

There is a paucity of information relating to grass DMI of the ewe during early lactation and the impacts of concentrate supplementation on total intake and performance of the grass fed, suckling ewe including her milk production. Our hypothesis stated that concentrate supplementation during early lactation does not improve the performance of the lactating ewe and her progeny during early lactation where sufficient quantities of grazed grass are available to meet requirements. The

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objectives of this study were to investigate how concentrate supplementation influenced the grass intake of the lactating ewe and subsequent ewe and lamb performance during the first seven wk post-partum.

2. Materials and methods

All experimental procedures carried out were conducted under experimental licence from the Irish Medicines Board in accordance with the European Union protection of animals used for scientific purposes regulations (2012) (S.I. No. 543 of 2012). This study was conducted at University College Dublin, Lyons Research Farm, Newcastle, Co. Dublin.

2.1. Animal management

Three hundred and thirty ewes, of mixed breed, were oestrus synchronised in October 2013 using intervaginal progestagen pessaries (Morlam, J & M Veterinary Services Ltd, Dublin.) followed by an intramuscular injection of 500 IU PMSG (J & M Veterinary Services Ltd, Dublin, Ireland.), before being individually inseminated with fresh diluted semen, at a rate of 20 million spermatozoa per uterine horn, using laparoscopic A.I. Semen from rams from a range of breeds including Belclare, Blueface Leicester, Charolais, Lleyn, Rouge L'ouest, Suffolk, Texel and Vendeen were used and semen was inseminated within two h of collection.

Post insemination the ewes were grazed in-situ on predominantly perennial ryegrass (Lolium perenne) swards without supplementation until December 1 (2013). From December 1 all ewes in-situ strip grazed forage rape (variety Hudson). On d 67 post-A.I., all ewes were group housed in straw bedded pens and offered a diet of ad libitum grass silage with a NDF content of 428.8 g per kg DM and CP content of 140 g per kg DM (McGovern et al., 2017). Ewes were pregnancy scanned and shorn on d 78 and 91 post-A.I. respectively. Twin-bearing ewes were offered concentrate supplementation daily from d 100 post-A.I. at a rate of 200 g fresh weight (FW) per ewe per d initially. This increased to 350 g FW per ewe per d from d 114 post-A.I until d 126 post-A.I. when it increased to 500 g FW per ewe per d for the remainder of gestation. Until d 126 of gestation a 14% CP concentrate was offered comprising 40% barley, 36% beet pulp and 20% distiller dried grains on a DM basis. After d 126 of gestation a 18% CP ration was offered comprising 40% barley, 22% beet pulp nuts, 20% distillers dried grains and 14% soya bean meal on a DM basis.

Fifty-four twin bearing and rearing ewes, were randomly allocated to one of three (n = 18) dietary treatments on d 7 (± two d) of lactation (experiment d zero). Ewes were blocked on ewe BCS at 24 h post-partum and treatment groups were balanced for ewe age, ewe breed, lamb sire breed, lamb sex, combined litter weight and for 24 h post-partum ewe live weight, longissimus dorsi muscle and fat depth. Until d 7 post-partum when experimental diets were introduced ewes received ad libitum grass silage (same silage as pre-partum diet) and 1 kg FW of a 180 g/kg CP concentrate with a ME content of 12.03 MJ/kg DM in two equal, daily allocations. The concentrate comprised of 40% barley, 22% beet pulp nuts, 20% distillers dried grains, and 14% soya bean meal on a DM basis. Treatments were as follows: GO = zero-grazed grass ad libitum from d 7 to d 49 post-partum, GC = zero-grazed grass ad libitum plus 500 g FW concentrate supplementation from d 7 to d 49 post-partum, GC21 = zero-grazed grass ad libitum from d 7 to d 49 post-partum plus 500 g FW concentrate supplementation from d 7 to d 21 post-partum.

Ewe BCS (zero to five scale; Jefferies, 1961) and live weight were recorded at 24 h post-partum, weekly from wk two to seven of lactation and at wk 14 of lactation (weaning) by one experienced practitioner. Longissimus dorsi muscle and fat depths were measured using ultrasound procedure in accordance with the procedure described by Signet Breeding Services (Davis, 2010) at 24 h post-partum, weekly from wk two to seven of lactation and at wk 14 of lactation.

Each ewe was penned independently with her progeny on slatted flooring at 72 h post-partum; these pens were also adjacent to a straw bedded creep area accessible to lambs only. Fresh water and ad libitum zero-grazed grass was offered to the lambs daily in the creep area. Ewe's received a magnesium bolus ('Rumbul Rumen Bollet for Sheep/Calf'; Agrimin, Kirimington, North Lincolnshire, UK) in wk one and four of lactation to prevent hypomagnesaemia.

2.2. Experimental diets

Zero-grazed grass was harvested from predominantly perennial ryegrass (*Lolium perenne*) swards. Mean pre-grazing herbage mass was determined weekly using a 0.25 m^2 quadrat as described by Campion et al. (2016), with a mean pre-grazing cover of 1100 kg DM/ha that ranged from 700 kg DM/ha to 1500 kg DM/ha. Fresh grass was harvested daily at 0730 h using a single chop zero-grazer (Zero Grazer, Dromone, Oldcastle, Co. Meath, Ireland.) set to a cutting height of 3.5 cm. Grass samples were collected daily from the harvested grass at 0830 h and 1630 h and frozen immediately at −20 °C. A further sample was collected at 0830 h and a rapid DM calculated by drying three, 50 g samples of grass at 120 °C for a minimum of four h and averaging the three results (Beecher et al., In press). Concentrate offered to GC and GC21 treatments was a 180 g/kg DM CP ration with an ME content of 12.03 MJ/kg DM as described previously for the pre-experimental diet. Concentrate samples were collected on three occasions each wk and frozen at −20 °C.

2.3. Feed management

At 0800 h grass refusals were removed and weighed, to calculate intakes. Grass was offered on a DM basis at 1.20 times the previous d DMI to ensure ewes had ad libitum access to grass. Grass DM for each day was obtained using the rapid DM figure calculated from the sample collected at 0830 h on the morning of feeding. Grass was offered to each ewe in individual allocations no greater than 3 kg fresh weight throughout the day until 1.20 times the previous d DMI was offered. Grass not required for feeding until after 1600 h was stored in a refrigerator at 4 °C until required. Concentrates were offered in a single feed at 0900 h. Ewe's had continuous access to fresh water.

2.4. Blood and rumen fluid sampling

Rumen fluid samples were collected immediately prior to the introduction of experimental diets and again seven d later by rumenocentesis at 08:30 h (prior to fresh feed being offered) using a modified version of the procedure described by Nordlund and Garrett (1994). A square approximately 5 cm by 5 cm was shaved immediately below the 13th rib. This area was washed and disinfected with Hibiscrub® (Regent Medical Overseas Limited; Two Omega Drive, River Bend Technology Park, Irlam, Manchester, UK) before a 20 mm by 18 gauge stainless steel noncoring needle (Sigma-Aldrich, Wicklow, Ireland) was inserted into the rumen through this site. A sample of between 8 and 10 ml of fluid was then withdrawn using a 20 ml syringe. Rumen fluid pH was immediately tested using a Thermo-Scientific benchtop pH meter standardized with certified pH 4 and 7 buffer solutions. Four ml subsamples were drawn off using an automatic pipette and acidified by mixing with 1 ml of trichloroacetic acid (50% wt/vol) before freezing at −20 °C.

Blood samples were collected at 08:30 h (prior to fresh feed being offered) on d 7, 28 and 49 of lactation (experiment d 0, 21 and 42) for glucose, beta-hydroxybutyrate (BHB), NEFA, plasma total protein and urea determination. Samples were obtained by ventricular venipuncture using heparinized vacutainers (BD, Plymouth, UK; Ref: 367 526). Blood samples were centrifuged immediately at 1800*g* for 20 min; the plasma was then drawn off using 6 ml disposable pipettes (Sarsted