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BRIEF COMMUNICATION: Do fetuses from primiparous one-year-old ewes differ from those of multiparous mature ewes?

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INTRODUCTION

The number of ewe-lambs (8 to 9 months of age) mated in New Zealand has increased to approximately 33% over the last 15 years (Anon, 2009). There are many potential advantages to ewe-lamb breeding including higher net profits, more lambs produced per ewe productive lifetime, better use of spring herbage, increased efficiency, early recognition of fertility potential and increased rates of genetic gain (Hight, 1982). However, little is known about the long term impacts of selecting progeny born to these young ewes as replacement animals. There is some evidence from human studies to suggest that there may be negative impacts for both the offspring and to the first parity young mother (Lucas *et al.*, 1999). The offspring tend to be lighter (Scholl *et al.*, 1994), have lower rates of survival as well as altered metabolic pathways and a predisposition to obesity and increased risk of coronary heart disease later in life (Barker, 2001). Work by Kenyon *et al.* (2009) using sheep, suggested that offspring born to young primiparous dams are programmed to deposit more abdominal fat which could have longer term implications for efficiency of growth and health.

Additional sheep studies have shown that lambs born to adolescent dams had lower birth weights, and smaller head length, crown-rump length and thoracic girth (Annett & Carson, 2006). However, these studies are often confounded by imposed nutritional regimes. Studies with adolescent ewes that were over nourished during early pregnancy show significant placental and fetal growth restriction as assessed during late gestation (Wallace *et al.*, 1996), due to the rapid maternal growth of the adolescent mother driving nutrient partitioning to maternal tissues. Although a similar study by Wallace *et al.* (2005) using mature ewes showed no effect. This indicates that the degree of maturity of the ewe at mating and the subsequent growth rate of the ewe during pregnancy may be a key factors influencing growth of the feto-placental unit.

The size and nutrient transfer capacity of the placenta plays an important role in determining the growth trajectory of the fetus (Mellor, 1983; Bell *et al.*, 1999). An indicator of intrauterine growth restriction is an increased brain:liver ratio (Regnault *et al.*, 1999). The growth of the brain is preserved relative to the rest of the body, especially to that of the abdominal organs (Wallace *et al.*, 2005). Therefore it is possible that the reduced fetal size in offspring born to young dams is driven by restricted placental development. There appears to be no sheep fetal studies which compare differences in the morphophysiology of near term fetuses from either primiparous 1-year-old ewe-lambs or mature multiparous ewes managed as one group during pregnancy which had been breed to the same sires. This study was undertaken to examine this point.

MATERIALS AND METHODS

The present study used nine single bearing primiparous Romney ewe-lambs (8 - 9 month-old, 47.0 ± 0.7 kg (± standard error)) and 11 single bearing Romney multiparous mature aged ewes (3 to 5 years old, 64.4 ± 1.5 kg) that had conceived within a 6 day period. Daily mating performance was not recorded. The 20 ewes were managed under commercial New Zealand grazing conditions with a minimum post grazing cover of 1,000 kg DM/ha until Day 145 (D145) of gestation. Ewe live weight was measured prior to the mating period, and at D87 and D145. At D145 ewes were euthanized, the gravid uterus removed, weighed and the fetus removed. Concomitantly the ewe liver, mammary gland and omental fat were removed and weighed. After removal of the fetus, the remaining uterine membranes were weighed and examined. Total placentomes and empty caruncles were counted to determine caruncle occupancy rate (%). Dressed carcass weight of the ewe and soft tissue depth at the 12th rib (GR) was also recorded. After being removed from the uterus, fetuses were euthanized and immediately identified for sex and measurements of body weight, crown rump length, thoracic girth, body volume, fore leg length, hind leg length, head length, and head width were taken. Fetal organs were weighed; brain, pineal gland, liver, kidneys, kidney capsule fat, heart, pericardial fat, lungs, pancreas, spleen, thymus, thyroid, adrenal glands, semitendinosus muscle, and either ovaries and mammary gland or testes. Fetal brain:liver ratio was calculated as an indicator of intrauterine fetal undernutrition (Lyon *et al.*, 2004). Data were analysed using a general linear model (Minitab, 2009). This study was conducted with the approval of the Massey University Animal Ethics Committee.

RESULTS

Ewe-lambs were lighter (P <0.05) than the mature ewes; prior to breeding (47.0 ± 0.7 kg vs 64.4 ± 1.5 kg, respectively), at D87 (48.2 ± 0.7 kg vs 66.2 ± 2.3 kg, respectively) and at D145 (61.3 ± 1.0 kg vs 79.2 ± 3.2 kg, respectively). Carcass weight, GR, liver weight, omental fat and mammary weight collected at D145 of pregnancy are detailed in Table 1. Not surprisingly mature ewes were significantly (P <0.05) larger than ewe-lambs for all of these parameters. Gravid uterus weight did not differ between the two ewe groups (P >0.05; Table 1). However, total placentome number was significantly (P <0.05) greater for ewe-lambs compared to mature ewes but their empty caruncle number and resulting occupancy rate did not differ (P >0.05; Table 2).

Fetuses from ewe-lambs tended to be lighter (P = 0.08) than those from mature ewes (Table 2). When analysed without fetal body weight as a covariate, fetuses from ewe-lambs had smaller (P <0.05) hind leg lengths, head lengths and brain weights (Table 2). However when analysed with fetal body weight as a covariate, these differences were no longer apparent (P >0.05). The sex of the fetus had no effect on any of the lamb size measurements taken (P >0.05). The organ weights for fetuses from either ewe-lambs or mature ewes did not differ (P >0.05) (M.F.P. Loureiro, Unpublished data). No differences were seen for any organ weights between male and female fetuses (P >0.05) (M.F.P. Loureiro, Unpublished data), with the one exception being total kidney weight, which was significantly heavier for males fetuses compared to female fetuses (27.5 ± 0.7 g vs 24.5 ± 0.7 g, respectively; P = 0.01).

TABLE 1: Mean (± standard error) measurements of live weight, dressed carcass weight, soft tissue depth at the 12th rib (GR), liver weight, omental fat and mammary weight, gravid uterus weight (analysed with and without fetal body weight as a covariate), total placentome and empty caruncle number and occupancy rate for primiparous ewe-lambs and multiparous mature ewes.

Parameter	Ewe-lamb	Mature ewe
Carcass weight (kg)	22.8 ± 0.7[a]	30.2 ± 1.4[b]
GR (mm)	14.9 ± 2.0[a]	21.2 ± 2.3[b]
Liver weight (kg)	0.87 ± 0.03[a]	1.14 ± 0.03[b]
Omental fat (kg)	0.95 ± 0.11[a]	2.01 ± 0.28[b]
Mammary weight (kg)	0.45 ± 0.06[a]	0.69 ± 0.07[b]
Gravid uterus (kg)	7.8 ± 0.4	8.5 ± 0.4
Gravid uterus (kg)*	8.2 ± 0.2	8.2 ± 0.2
Total placentomes (number)	105 ± 5[b]	89 ± 5[a]
Empty caruncles (number)	24.4 ± 4.2	36.1 ± 8.2
Occupancy rate (%)	81.5 ± 2.5	72.8 ± 5.1

*Analysed with fetal body weight as a covariate.
Different superscripts within rows indicate values that significantly differ (P <0.05).

TABLE 2: Mean (± standard deviation) measurements of foetal body weight, hind leg length, head length and brain weight at D145 for foetuses from either primiparous ewe-lambs or multiparous mature ewes.

Parameter	Ewe-lamb	Mature ewe
Foetal body weight (kg)	5.1 ± 0.2	5.7 ± 0.2
Hind leg length (cm)	35.6 ± 0.5[a]	37.2 ± 0.5[b]
Head length (cm)	17.1 ± 0.2[a]	17.5 ± 0.1[b]
Brain weight (g)	49.2 ± 0.8[a]	52.3 ± 1.1[b]
Brain:Liver ratio	0.44 ± 0.02	0.40 ± 0.03

Different superscripts within rows indicate values that significantly differ (P <0.05).

DISCUSSION

The D145 single fetuses examined here, from primiparous ewe-lamb dams were similar to those from multiparous mature aged dams. This is contrary to expectations as Annett and Carson (2006) showed young primiparous dams gave birth to lighter/smaller lambs. However, this study imposed nutritional treatments and took pregnancy through to term.

The change in total ewe live weight in this study, from breeding to D145 was 14 kg and 15 kg for ewe-lambs and mature ewes respectively. While accurate herbage measurements were not collected ewe liveweight changes observed were greater than the gravid uterus weights, 7.8 kg and 8.5 kg for ewe-lambs and mature ewes respectively. These are similar to previously recorded weights of a single-bearing ovine gravid uterus weights(Rattray *et al.*, 1974). This suggests that in the present study ewes were not under restricted nutritional conditions, although the lack of any herbage measurements mean this cannot be verified. Ewe GR and fetal brain:liver ratio also supports this. Evidence from studies where no nutritional restriction was applied show that lambs born to young primiparous dams did not differ to those from multiparous dams (Trail & Sacker, 1969; Macedo & Hummel, 2006), which supports the findings from this study.

A significant proportion of fetal growth occurs in the last week of gestation and live counterparts of these fetuses will be studied to investigate if differences are present at birth. Performance and growth post birth will be monitored.

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