

PLACENTAL EFFICIENCY AND MORPHOLOGY IN EWES AS INFLUENCED BY GENETIC GROUP, AGE, WEIGHT AND LITTER CHARACTERISTICS

ANILKUMAR, R¹. AND M.IYUE

Sheep Breeding Research Station,
Tamil Nadu Veterinary and Animal Sciences University
Sandynallah - 643 237. The Nilgiris District. Tamil Nadu

Received : 12.02.15

ABSTRACT

Accepted : 21.07.15

The effects of breed, age, weight of ewes, litter size, litter weight and sex of lamb on placental characteristics and placental efficiency were studied in the present study to establish the fact that they determine the birth weight. Average placental weight was recorded as 307.66 \pm 14.24 g. Ewes with good body weight at breeding had significantly heavier placenta. Twin bearing ewes, ewes with male lambs and higher litter weight had higher placental weight. Weight of placenta had a positive correlation with length and width of placenta and also with the number of big and small cotyledons. Among the three genetic groups studied Dorset X Nilagiri cross bred ewes had longer placenta with bigger cotyledons and more number of cotyledons than Nilagiri and Sandyno ewes. Litter size and sex of lamb had significant effect on the placental length. Ewes with twins and ewes with male lambs had higher placental length, bigger cotyledons and more number of cotyledons. Average placental efficiency was 10.72 \pm 0.20 g. Litter weight at birth and placental weight had significant effect on placental efficiency and were significantly higher in twin bearing ewes than single lambs.

Key words: Ovine, Placenta, Breed, Litter size, Litter weight, Placental efficiency

Survivability and future performance of the lambs are determined by their weight at birth. Several factors like breed, age of dam, parity, weight of dam at mating, litter size and sex of lamb influence the birth weight of lambs (Jenkinson *et al.*, 1995; Kaulfuss *et al.*, 2000). Growth of fetus is at its maximum (~ 80 %) during the final third trimester of pregnancy. Hence the size and nutrient transfer capacity of the placenta during this period plays a critical role in determining the prenatal growth of fetus and directly influence the birth weight and postnatal survivability of lambs (Bell *et al.*, 1999; Wallace *et al.*, 1999). The ovine placenta is polycotyledonary, consisting of placentomes composed of maternal (caruncles) and fetal (cotyledons) tissues where exchange between the maternal and fetal circulation happens. Thus the placental exchange in ovine placenta is dependent on the number and size of the placentomes, which in turn influences the placental capacity and fetal growth

(Jenkinson *et al.*, 1995; Kaulfuss *et al.*, 2000). In India, the placental characteristics of Patanwadi crossbred sheep was only reported (Jacob and Vadodaria, 2002). No studies in other breeds of sheep were reported. Hence the effects of breed, age, weight of ewes, litter size, litter weight and sex of lamb on placental characteristics and placental efficiency were studied to establish their relationship with the birth weight.

The placental materials for this study were collected from 102 ewes belonging to three genetic groups (Nilagiri, Sandyno and Dorset X Nilagiri cross). The placenta were collected immediately after delivery in plastic bags with proper identification of ewes and were brought to the laboratory for analysis. Each placenta was carefully washed and blotted dry and weighed using standard electronic balance. The length and width of the placenta were measured with the help of a measuring tape. Cotyledons were

measured individually for their size using Vernier calipers and divided into small (≤ 2 cm) and large (>2 cm) sizes.

The weight of the dam at breeding and at lambing, age of the dam at lambing, birth weight of lamb, litter size, litter weight and sex of lambs were collected for individual ewes from the breeding and lambing records available in this station.

Placental efficiency is most commonly defined as the gram of fetus produced per gram of placenta (Wilson and Ford, 2001). The placental efficiency was arrived at by dividing the litter weight by placental weight.

The effect of breed, age, weight of ewes, litter size, litter weight and sex of lamb on placental weight, length, width, total number of cotyledons, number of big cotyledons and placental efficiency were analyzed by least square procedure (Harvey, 1990). The correlation between various placental characteristics and placental efficiency were analyzed by Microsoft excel programme.

The average placental weight was 307.66 ± 14.25 g (Table 1). The observed placental weight was higher than those reported for Patanwadi cross bred sheep (Jacob and Vadodaria, 2002) and lower than Blackface and Suffolk sheep (Wallace *et al.*, 2001; Dwyer *et al.*, 2005). There was no significant variation in placental weight among the breeds studied. Ewes with good body weight at breeding had significantly heavier placenta ($P < 0.05$). Ewes with higher litter weight ($P < 0.05$) had higher placental weight. The effect of litter weight, litter size, body weight of ewes and sex of lamb on placental weight in this study is similar to previous studies by Greenwood *et al.* (2000) and Dwyer *et al.* (2005). Weight of placenta had a positive correlation with length and width of placenta and also with the number of big and small cotyledons. The presence of more number of cotyledons may have increased the weight of placenta.

The length of placenta was longer in Dorset X Nilagiri cross bred ewes as compared to Nilagiri and Sandyno ewes. The placental length observed in this study was higher than those observed by Jacob and Vadodaria (2002) in Patanwadi cross bred sheep.

Litter size and sex of lamb had significant effect on the placental length. Ewes with twins ($P < 0.01$) and ewes with male lambs ($P < 0.05$) had higher placental length and placental weight. The placental width was negatively correlated with placental efficiency.

The number of larger and total cotyledons were more in Dorset X Nilagiri cross bred ewes than Nilagiri and Sandyno ewes. Total cotyledons were 82.37 ± 4.50 and big cotyledons were 20.60 ± 3.43 . The number of cotyledons found in the present study were twice than those recorded by Jacob and Vadodaria (2002) for Patanwadi cross bred ewes. However, they were similar to studies under taken in exotic germ plasm (Greenwood *et al.*, 2000; Wallace *et al.*, 2004; Dwyer *et al.*, 2005; Fowden *et al.*, 2009).

Litter size had significant effect on the number of cotyledons with twin bearing ewes having more number of large cotyledons ($P < 0.05$) and more number of total cotyledons ($P < 0.05$) than single bearing ewes. Twinning increased placental weight, the number of cotyledons and number of large cotyledons over single bearing ewes (Greenwood *et al.*, 2000; Wallace *et al.*, 2004; Dwyer *et al.*, 2005; Fowden *et al.*, 2009). However, the placental surface area for individual lambs in twin pregnancy is less than single lamb. This is compensated to certain extent by increase in the number of large cotyledons. Total cotyledons were positively correlated ($P < 0.01$) with placental weight, length and number of small cotyledons. It was observed that higher the length of the placenta more were the number of large cotyledons ($P < 0.05$).

The average placental efficiency was 10.72 ± 0.20 . Placental efficiency calculated in the current study was similar to the works by Wallace *et al.* (2004); Dwyer *et al.* (2005). Ewes aged 4-5 years of age (12.05 ± 0.25) and twin bearing ewes (11.07 ± 0.40) had higher placental efficiency. As the age and parity advances, the placental efficiency is also increased (Dwyer *et al.*, 2005). Placental efficiency was higher in ewes bearing twins or multiples and ewes with heavier placenta ($P < 0.01$). Significantly negative correlation was observed between the width of placenta and placental efficiency. Similarly there was a significantly negative correlation (-0.256) with placental efficiency and placenta having higher number of large cotyledons.

Table 1. Effect of breed, age, weight at lambing, litter size, litter weight and sex of lamb on placenta weight and placental components

| CHARAC | | Placental Weight | Placental Length | Placental Width | Total caruncle | Big caruncle | Placental Efficiency |
|------------------------|-----|------------------|------------------|-----------------|----------------|--------------|----------------------|
| Overall | 102 | 307.66±14.25 | 130.81±5.29 | 39.07±2.16 | 82.37±4.50 | 20.60±3.43 | 10.72±0.20 |
| Breed | | NS | * | NS | NS | NS | NS |
| Nilagiri | 35 | 318.15±14.72 | 121.89±5.47 | 41.08±2.23 | 77.68±4.64 | 19.13±3.61 | 10.75±0.21 |
| Sandyno | 55 | 298.28±16.09 | 125.88±5.97 | 37.50±2.44 | 78.90±5.08 | 17.48±3.81 | 10.81±0.22 |
| Dor x nil | 12 | 306.55±21.70 | 144.67±8.06 | 38.64±3.30 | 90.53±6.85 | 25.20±5.15 | 10.59±0.30 |
| Age | | NS | NS | NS | NS | NS | NS |
| 1-2 | 7 | 302.30±22.63 | 137.02±8.40 | 38.93±3.44 | 85.42±7.15 | 17.57±5.35 | 10.41±0.31 |
| 2-3 | 29 | 319.55±16.56 | 121.63±6.15 | 39.51±2.52 | 82.20±5.23 | 17.50±4.03 | 10.74±0.23 |
| 3-4 | 20 | 309.03±19.26 | 137.03±7.15 | 38.47±2.93 | 82.90±6.08 | 21.66±4.59 | 10.63±0.27 |
| 4-5 | 21 | 302.20±18.03 | 125.89±7.00 | 41.91±2.74 | 76.49±5.69 | 21.70±4.28 | 12.05±0.25 |
| >5 | 25 | 305.22±17.54 | 132.49±6.51 | 36.55±2.66 | 84.83±5.54 | 24.58±4.18 | 10.74±0.24 |
| WTB¹ | | * | NS | NS | NS | NS | NS |
| <21 | 24 | 280.66±14.25 | 126.47±7.06 | 36.84±2.89 | 85.61±6.01 | 19.79±4.46 | 10.63±0.26 |
| 21-25 | 22 | 315.17±17.35 | 124.53±6.44 | 38.83±2.63 | 82.28±5.48 | 21.47±4.18 | 10.57±0.24 |
| 26-30 | 30 | 300.56±16.33 | 134.49±6.06 | 39.40±2.48 | 81.59±5.16 | 21.22±3.88 | 10.73±0.22 |
| >30 | 26 | 334.66±19.06 | 137.74±7.08 | 41.23±2.90 | 80.00±6.02 | 19.93±4.71 | 10.93±0.27 |
| WTL² | | NS | NS | NS | NS | NS | NS |
| <21 | 24 | 314.30±16.00 | 129.21±5.94 | 39.70±2.43 | 77.97±5.05 | 21.18±3.86 | 10.64±0.22 |
| 21-25 | 20 | 311.88±18.11 | 128.08±6.72 | 40.93±2.75 | 88.03±5.72 | 22.04±4.34 | 10.64±0.25 |
| 26-30 | 30 | 313.63±16.63 | 135.91±6.18 | 38.50±2.53 | 83.29±5.25 | 19.07±4.01 | 10.73±0.23 |
| >30 | 28 | 290.83±20.21 | 130.04±7.50 | 37.16±3.07 | 80.19±6.38 | 20.12±4.75 | 10.86±0.27 |
| Litter size | | * | ** | NS | * | * | NS |
| Single | 95 | 271.36±08.00 | 120.99±2.97 | 39.67±1.22 | 70.29±2.53 | 17.03±1.88 | 10.37±0.11 |
| Multiple | 7 | 343.96±28.56 | 140.63±10.61 | 38.47±4.34 | 94.45±9.03 | 24.17±6.91 | 11.07±0.40 |
| Lamb sex | | * | * | NS | NS | NS | NS |
| Male | 54 | 321.36±14.90 | 136.48±5.53 | 39.17±2.26 | 80.00±4.70 | 21.74±3.67 | 10.75±0.21 |
| Female | 48 | 293.96±15.84 | 125.14±5.88 | 38.98±2.41 | 84.74±5.00 | 19.47±3.74 | 10.68±0.22 |
| Litter weight | | * | NS | NS | NS | NS | ** |
| Placental Weight | | --- | | | | ** | ** |

¹WTB → Weight at breeding

²WTL → Weight at lambing

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