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Growth performance and survival rates of Desert lambs under grazing condition in North Kordofan State, Sudan

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Abstract

The experiment was conducted to evaluate the growth performance and survival rate of desert lambs under traditional conditions in North Kordofan State, Sudan. The non-genetic factors (parity, type of birth and sex of lambs) were also determined. Eighty (88) lambs were selected from the flock of Desert sheep for this study. Lambs were ear taggepartiesed and divided into three groups according to their mother parties as 1st, 2nd and 3rd parties. Lambs were depending on natural pasture for grazing. Data were analyzed using the F test for analysis of variance and Duncan test to assess the significant differences between means. All fixed non genetic factors were significantly (P <0.05) affecting the birth weight, weaning weight, average daily gain and survival and mortality rate except parity order. Body weight/kilograms at birth, 0-90 days, average daily gain grams/day and pre weaning survival rate of lambs (n=88) were evaluated. The least squares mean (±SE) of BW at birth, 30, 60 and 90 days (weaning) of age were 2.08± 0.11, 5.05± 0.13, 7.76± 0.18 and 9.97±0.25 kg, respectively. The overall means of average daily gain grams/day and pre weaning survival rate were 87.49±1.46 g/day and 98.7% respectively.

Also, the results revealed that lambs from 3rd party were heavier at birth, weaning and larger average daily gain compared with lambs from 2nd and 1st parties. The results indicated that the type of birth was significantly (P <0.05) affected the birth weight, where the single lambs was recorded high weight followed by the twin and triplets' lambs as 2.29, 1.57 and 1.43 kg, respectively. Male lambs excelled females in birth weight, weaning weight, average daily gain and survival rate (P <0.05). Type of birth was significantly (P <0.05) affecting the weaning weight and average daily gain, as10.23 ± 0.23 vs 9.77 ± 0.54 kg and 93.58 ± 4.95 vs 85.75 ± 2.09 g/day of weaning and average daily gain for single and twin lambs respectively. On other side triplet lambs recorded lower weight on weaning and daily gain as 8.00 ± 1.80 kg and 73.30 ± 16.42 g/day respectively. High survival rate explained by 2nd, 3rd parities, single, twin lambs and male lambs. In conclusion birth weight, pre-weaning growth, weaning weight, average daily gain and survival rate were significantly affected by type of birth and sex. Parity did not influence any of the traits studied. To increase production and growth performance of sheep, managing dam age through replacement ewes, and improving nutrition and litter size would improve lamb survival and growth that enhances total lamb output per ewe per year.

Keywords: Desert sheep; Growth; Body weight; Survival; Sudan

Introduction

Small ruminant production is an important agricultural enterprise in Sudan. Sheep are important components of the livestock subsector and are sources of cash income and play a vital role as sources of meat and milk, they are also sources of foreign currency. Moreover, due to their high fertility, short generation interval, adaptation in harsh environment and their ability to produce in limited feed resource they are considered as investment and insurance [1,2]. Desert sheep is one of the identified indigenous sheep breeds of Sudan. They are managed under low input extensive production systems. Like other breeds of the country, desert sheep can be characterized by low productivity in terms of growth rate, meat production, and reproductive performance, which can be attributed to poor nutrition, and the resultant stress that provides a rich atmosphere for disease and serious production losses. Growth performance is the most important production trait for evaluating successful animal production potential, which determines the overall productivity of the flock and the economic return from sheep

production enterprise [3]. Fast growth performance allows sheep to breed early and contribute more lambs in their lifetime. A fast growth rate entails reaching market weight early and brings a quicker income to the farmer. The growth performance of sheep is influenced by age of the dam, pre-mating weight of the dam, type of birth and sex [4-6]. Birth weight, pre-weaning growth rate of lambs and survival rate have been investigated in several areas on several sheep breeds under varying environmental and/or management conditions and trying to understand of the influence of some of non-genetic factors such as parity and litter size on these traits [7-9].

Live weight and growth rate are economically critical features, requiring particular attention in any breeding program intended to improve overall productivity since lambs are mainly raised for meat [8,10]. Birth weight affects the survival rate and pre-weaning growth of the lamb [11]. Pre-weaning growth performance of lambs depends on the inherent genetic potentiality and the mothering ability of ewes [12]. Studies carried out on different breeds demonstrated that parity had an influence on lamb mortality, lamb birth weight, lamb weaning weight, lamb postnatal growth rate, lambing interval, milk yield and milk quality [13]. The neonatal period is very decisive in the rearing of lambs. During this period, mortality is a major factor limiting profitability in sheep farming [14]. Reductions in lamb mortality rate would significantly increase lamb output (survival rate) and this can be achieved only by identifying and targeting its specific causes [15]. Though the sheep contributes significantly to the economy of Sudan, it is imperative to increase its productive performance to meet the ever-increasing demand for animal proteins. This objective can be achieved by increasing the number of lambs successfully reared per ewe in each season. Therefore, the objective of this study was to evaluate non-genetic factors affecting the growth traits and survival rate of desert lambs under extensive conditions in North Kordofan, Sudan.

Materials and Methods

The present study was conducted at Foja village, Bara locality, North Kordofan State, Sudan during December 2016 to November 2017 (Longitudes 31.47°-30.05° N, Latitudes 14.37°-13.34°E). The mean monthly temperature ranged from 31.3 C° in April to 25.8 C° in July, annual rainfall ranging between 500-800 mm, with peak rain in August [16].

Experimental animals

Eighty (80) ewes in different parities reared in natural grazing were selected from the flock of Desert sheep during the normal breeding season (February-March) for this study. Ewes were ear tagged, weighed and divided into three groups according to their parities as 1st, 2nd and 3rd parities. The born lambs (Eighty-eight 88) from those ewes were assigned to their mothers' groups. All ewes and lambs were depending on natural pasture for grazing. After parturition, all lambs were marked with ear tag and remained with their dams for 24-48 h, lambs monitored from birth to weaning. Lambs were treated with the necessary medication against endo-and ecto-parasites (AGVET, USA 1.0 ml/50 kg body weight subcutaneously Ivomec super drench). All lambs were kept in separate enclosures constructed from iron bars and wire and equipped with feeders and water troughs. Inside each enclosure the animals were individually tethered at a sufficient distance away from each other. Lambs were allowed to suckle their mothers daily, then turned and maintained to grazing on pasture from 8.00 am to 6.00 pm. Lamb body weights were recorded at birth and then were weighed at monthly intervals from birth to weaning. Lamb birth and weaning weight were estimated by weighing the lambs at these times. Growth rates were derived by taking the difference within the period from birth to weaning and dividing it by the time interval in days. Lamb and litter weights at weaning were adjusted to 90 days. The lambs were fasted overnight before being weighed. Birth weight and 90 days weight were taken using 50kg weighing balance with 200g precision.

Statistical analysis

The data were statistically analyzed according to a complete random design. All techniques of the statistical analysis were conducted using Statistical Package for the Social Sciences, software package [17]. Duncan's Multiple Range Tests (DMRT) was also used to test significant differences among means; analysis of covariance was carried out.

Results

Effect of parity order, birth type and sex on lamb's birth weight

The non-genetic factors considered in this study were shown significantly ($p<0.05$) to affect birth weights of desert lambs except parity (Table 1). Parity (dam age) due to differences in ewe weight influenced body weights of lambs at birth but not significant, despite that lambs born from 3rd parity attained higher weight (2.60 ± 0.14 kg) compared to those from the 2nd and 1st parities as 2.20 ± 0.08kg and 2.06 ± 0.10kg respectively. Birth type exerted significant ($p<0.05$) effect on birth weight, whereas Single births showed consistently higher body weights over their twin and triplet counterparts. Likewise, twin births were higher compared to triplets at birth ($P<0.05$). They had recorded 2.29 ± 0.05 kg, 1.57 ± 0.12 kg and1.43 ± 0.40 kg for single, twin and triplets respectively (Table 1). Sex of lambs seemed to have significant ($p<0.05$) effect on lamb's birth weight. Males were significantly ($p<0.05$) heavier than females, males were heavier at birth 2.32 ± 0.06 kg than female which scored lowest weight 1.77 ± 0.07 kg (Table 1).

Effect of parity, birth type and sex of lamb-on-lamb growth performance

Each of the two major factors (type of birth and sex of lamb) considered in this experiment had significant effect ($P < 0.05$) on

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lamb growth performance expect of parity order during the study period 90 days (Table 2). Lambs born from the 2nd and 3rd parties from 0-30 days recorded better weight compared to 1st parity, but for 30-60 days 3rd parity secured higher performance than 2nd and 1st parties. In the last period 60-90 days 2nd and 3rd parties demonstrated higher weight compared to 1st parity. Type of birth had significant ($p<0.05$) effect on growth rate during 0-30 and 60-90 days. Single lambs recorded a higher growth rate compared with twin and triplets' lambs during that period. Single lambs secured 3.80±0.08 kg, 5.28±0.11kg and 10.23±0.23kg; twin lambs 3.04±0.19kg, 4.54±0.27kg and 9.77±0.54kg and finally triplet lambs scored the lower growth rate as 2.70±0.63kg, 3.70±0.63kg and 8.00±1.80kg during 0-30, 30-60 and 60-90 days from birth respectively. There were high significant ($P<0.001$) effects of sex on growth rate and the influence till 90 days (weaning) (Table 2). Male lambs were superior to their female counterparts at birth, 0-30, 30-60 and 60-90 days. However, male kids were recorded 5.42±0.12kg, 8.24±0.16kg and 10.55±0.23kg compared with female which were recorded 4.57±0.13kg, 7.16±0.19kg and 9.22±0.26kg during 0-30, 30-60 and 60-90 days respectively.

Table 1: Effect of parity, birth type and sex on lambs' birth weight.

Variables	No. of lambs	Means ±SE
Parity order		
1st parity	22	2.06 ± 0.10
2nd parity	48	2.20 ± 0.08
3rd parity	18	2.60 ± 0.14
Birth type		
Single	63	2.29 ± 0.05[a]
Twin	22	1.57 ± 0.12[b]
Triplets	3	1.43 ± 0.40[c]
Sex of lambs		
Male	49	2.32 ± 0.06[a]
Female	39	1.77 ± 0.07[b]
Overall mean± SE	88	2.08 ± 0.11

[abc] Values in the same column followed with different letters are significant at $P<0.05$.

Effect of parity order, birth type and sex of lambs on lamb weaning weight and daily body gain

All fixed factors had significant ($P<0.05$) effect on weaning weight and pre-weaning average daily gain except parity (Table 3). Parity order had no significant effect on weaning weight. Despite that lamb's weight increase with increase parity order, weaning weight recorded as 9.83±0.40 kg, 10.06 ± 0.28 kg and 10.16 ± 0.52 kg for 1st (primiparous), 2nd and 3rd parities respectively. Also, Parity order had no significant effect on daily weight gain, lambs from 2nd parity showed faster pre-weaning average daily gain (87.23 ± 2.6g/day) in comparison to 3rd (86.85 ± 4.83g/day) and 1st (85.72± 3.65g/day) parities. Birth type had significant ($p<0.05$) effect on weaning weight and daily gain (Table 3). whereas single kids had registered higher value weaning and daily gain as (10.23±0.23kg and 93.58±4.95g/day) compared with twin lambs (9.77±0.54kg and 85.75±2.09 g/day) and triplets lambs which secured lowest value of weaning and daily gain as (8.00 ±1.80kg and 73.30 ± 16.42g/day) (Table 4). Birth type had significant ($p<0.05$) effect on weaning weight and daily gain (Table 3). Single births demonstrated higher weaning weight (10.23±0.23kg) than twin (9.77±0.54kg) and triplets (8.00 ±1.80kg) lamb. Twins' lambs were heavier than triplets. Likewise, lambs from the single demonstrated higher ($P<0.05$) 90-day daily gain (93.58±4.95g/day) compared to twin (85.75±2.09 g/day) and triplets (73.30 ± 16.42g/day) lambs. Similarly, twin lambs attained significantly higher body weights gain compared with triplet lambs at 90 days. Sex of lambs had significant ($p<0.05$) effect on weaning weight and daily gain weight. However, male lambs had recorded higher weight compared with female lambs, subsequent value were 10.55 ± 0.23kg vs 9.22 ± 0.26kg weaning weight for male and female respectively and 91.39 ± 2.20 g/day vs 82.46 ± 2.50g/day daily gain for male and female respectively (Table 3).

Table 2: Effect of parity, birth type and sex on lambs' growth performance.

Variables	No. of lambs	0-30 day	30-60 day	60-90 day
Parity order				
1st parity	21	5.00 ± 0.21	7.69 ± 0.29	9.83 ± 0.40
2nd parity	48	5.21 ± 0.15	7.88 ± 0.21	10.06 ± 0.28
3rd parity	18	5.21 ± 0.27	7.94 ± 0.39	10.16 ± 0.52
Birth type				
Single	62	5.28 ± 0.11a	7.92 ± 0.17	10.23 ± 0.23[a]
Twin	22	4.54 ± 0.27b	7.46 ± 0.40	9.77 ± 0.54[b]
Triplets	3	3.90 ± 0.90c	6.30 ± 1.32	8.00 ± 1.80[c]
Sex of lambs				
Male	49	5.42 ± 0.12 a	8.24 ± 0.16 a	10.55 ± 0.23[a]
Female	38	4.57 ± 0.13 b	7.16 ± 0.19 b	9.22 ± 0.26[b]
Overall mean	87	5.05± 0.13	7.76± 0.18	9.97± 0.25

[abc] Values in the same column followed with different letters are significant at $P<0.05$ and/or $P<0.01$.

Effect of parity, birth type and sex of lamb on lamb's mortality rate

Parity order, birth type and sex of lambs also excreted significant ($p>0.05$) effect on mortality and survival rate (Table 4). With The maximum survival rate 98.7% and 2.6 mortality rate. Looking at desert flocks, showed that mortality of lambs varied significantly ($p>0.05$) with the age of the dam, being highest in

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1st (primiparous) parity ewes with 4.5% mortality rate and 95% survival rate and lowest mortality and higher survival rate in 2nd and 3rd parities ewes. Single and twin had a higher survival rate compared with triplet lambs. The mortality rate of triplet births reached to1.59% and was not significant. Sex of lamb had exerted significant ($p<0.05$) effect on mortality rate, where female lambs recorded higher mortality rate than male lambs, like wise male demonstrated high survival rate 100% (Table 4).

Table 3: Effect of parity order, birth type and sex of lambs on lamb weaning weight and daily body gain.

Variables	No. of lambs	Weaning weight/kg	Daily body weight gain/g
Parity order			
1st parity	21	9.83 ± 0.40	85.72± 3.65
2nd parity	48	10.06 ± 0.28	87.23 ± 2.61
3rd parity	18	10.16 ± 0.52	86.85 ± 4.83
Birth type			
single	62	10.23 ± 0.23 [a]	93.58 ± 4.95 [a]
twin	22	9.77 ± 0.54 [b]	85.75 ± 2.09 [b]
triplets	3	8.00 ± 1.80 [c]	73.30 ± 16.42 [c]
Sex of lambs			
Male	49	10.55 ± 0.23[a]	91.39 ± 2.20 [a]
Female	38	9.22 ± 0.26[b]	82.46 ± 2.50 [b]
Overall mean	87	9.97 ± 0.21	87.49 ± 1.46

[abcd] Values in the same column followed with different letters are significant at $P<0.05$.

Table 4: Effect of parity, birth type and sex of lamb-on-lamb survival and mortality rate.

Variables	No.of lambs	Mortality rate	Survival rate
Parity order			
1st parity	22	4.5	95.5
2nd parity	41	0	100
3rd parity	12	0	100
Birth type			
Single	63	0	100
Twin	22	0	100
Triplets	3	1.59	98.41
Sex of lambs			
Male	49	0	100
Female	38	2.6	97.4
Overall mean	88	2.6	98.7

Discussion

Effect of parity order, birth type and sex on lamb's birth weight

Birth weight is an economically important trait in livestock production. It is a measure of prenatal growth, which affects partially in post-natal development. In this study the mean birth weight was found to be 2.08 ± 0.11kg, our finding also corresponds with El-Hag et al. [18], Idris et al. [19], Bushara and Salih [20], and lower than finding of Rihawi et al, [21], Bela, and Haile [22], Abegaz et al. [23] and higher than that reported by Hossain et al. [24]. The effect of parity of dam on birth weight is thus imparted as maternal influence whose direct influence is limited to the nursing period. In this study parity number seemed to have no significant effect on birth weight, same results were obtained by Assan and Makuza [25], Macedo and Hummel [13], Aliyari et al. [26], Akta¸s and Do˘gan [27], Akta¸s et al. [28] and Freitas-de-Melo et al, [29] those researchers could not find any significant differences between the ewe age groups in terms of birth weights. Despite that in this study lambs born to ewes in third parity secured higher birth weight. On other hand many scholars reported parity of the dam affected ($P<0.001$) birth weight of lambs; dams with higher parities lambed heavier lambs a similar result [4,23,30-32].

Also, Freitas-de-Melo et al. [29] demonstrated that lambs born from primiparous mothers are lighter and thus, slower to stand up and suckle for the first time than lambs born from multiparous mothers, the highest live weight produced lambs with the highest birth weight, since pregnancy is a greater metabolic challenge for primiparous than for multiparous ewes, it would appear that, primiparous ewes prioritized the foetus at the cost of their own growth. The scientific explanation forwarded for the increased trend of lamb's weight at birth with increase in dams' parity or age at lambing because the heavier birth weight in later parities is attributed to heavier dam weight, larger size, and physiological imprint in the uterus during the first pregnancy which supports relatively greater foetal growth in subsequent pregnancies [33]. Also, could be due to better mothering ability from the later party than the first party. Indeed, younger ewes were still growing and there would have been a conflict with maternal nutritional needs and a competition for nutrients for growth of young ewes and growth of fetus, and the favorable uterine environment provided by the older ewes [34,35]. Generally, it can be said that, in this study the lambs born from primiparous ewes were lighter than lambs born from multiparous ewes.

Similarly, type of birth lend itself as potential effects on birth weight, that Lambs born as singles were 0.72 kg heavier ($p < 0.001$) than twins, 0.86 kg heavier than triplets. This agrees with the works of other authors as, Taye et al. [30]; Abegaz et al. [23]; Yiheyis et al. [35]; Koncagül et al. [32]; Akta¸s and Do˘gan [27]; Akta¸s et al. [28]; Gemiyo et al. [36]; Pesántez-Pacheco et al. [37]; Habtegiorgis et al. [9] and Hagan et al. [11]. The finite capacity of the maternal uterus space to hold foetus, coupled with the competition between foetuses for available space and nutrients in the uterus contribute to the lighter weights of multiple births [33,38]. As litter size increases individual birth weights decline, this result agrees with literature of [4,39-41]. The slightly lower weight of twins in the adjusted group may, however, be attributed to the insufficient frequency (fortnightly) adjustment which resulted, perhaps, in a slight undernourishment. In addition, the

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diminished nutrition supply via blood vessels during prenatal life as the number of foetuses in utero increase, the number of councils attached to each foetus decreases, thus reducing the feed supply to the foetus and hence a reduction in the birth weight of multiple born lambs, which agreed with Gootwine et al. [42] and Yiheyis et al. [35]. Also, Parraguez et al. [43] reported that in twin-bearing ewes, undernourishment during pregnancy lowers the birth weight and increases morbidity and mortality of lambs. Litter-size-dependent intrauterine growth restriction is evident at mid gestation when metabolic needs of the conceptus are moderate, and over nutrition of ewes with multiple foetuses does not promote growth of their foetuses to the size of singletons [41]. Generally, the heavier birth weight for singles lambs might be attributed to the intrauterine environment where a higher availability of nutrients to the single lamb, lack of competition as well as more space may facilitate growth, which the foetus does not have to share with its littermates, thereby attaining higher body weight than the twin or triplet born lambs.

In this study birth weight was significantly ($P < 0.05$) affected by sex of lamb, male kids weighed significantly heavier by 0.55 kg than females' counterparts at birth. Consistent superiority of male kids has been widely reported by Ozder et al. [44]; Bela, Haile [22]; Mengistie et al. [4]; Taye et al. [30]; Abegaz et al. [23]; Koncagül et al. [32]; Aktas AH, Do˘gan S [27]; Aktas et al. [28] and Pesántez-Pacheco et al. [37]. Other studies, however, reported contrary results that sex of lamb did not affect birth weight [45]. In general, male lambs tend to be heavier than female lambs. These differences can be explained by the different hormonal profiles of male and female fetuses in their endocrinological and physiological functions, which stimulates skeletal growth [8,9,22].

Effect of parity, birth type and sex of lamb-on-lamb growth rate

In this study, ewe parity did not influence lamb growth rate and pre-weaning gain weight from birth to weaning. This finding corroborates some earlier reports by Macedo and Hummel [13]; Benyi et al. [46] and Gbangboche et al. [47]. Despite non-significant, lambs from dams born three times grew twice as much as lambs born to 2nd and primiparous ewes. The efficiency of Preweaning growth was also reported by Marufa et al. [48] to decrease with the advancement of parity. Relative competition for nutrients between the still growing young dams and the developing foetus, may be the cause of depressed growth performance in lambs. It has been demonstrated that primiparous ewes produce less milk [28] and therefore, their lambs grow at a slower rate than those from multiparous ewes [49], which may very well affect their nutritional independence from their mother and the strength of bond during lactation. Contrary to the present results Gardner et al. [33], Yiheyis et al. [35], Idris et al. [50] reported the effect of parity had consistently a significant effect ($p<0.05$) on growth performance increased up to fifth parity and a decrease in growth performance was observed at sixth parity.

Bela and Haile [22] demonstrated that the lambs born to ewes at first party had lower weight for ages and weight gains compared to subsequent parities. This could be due to the difference in milk supply and maternal care, since lighter and maiden ewes may be first-time lambing, young ewes, produce less milk than average and lack experience to take care of their lamb, which might result in poorer maternal care. Less-developed mammary glands and, therefore, insufficient milk production for their lambs may be the reason for lighter lambs from 2- year-old ewes. Influence of superior maternal environment of older ewes is expected to be translated into better lamb performance up to weaning due to milk production [34]. This might be explained by the greater milk yield produced by multiparous ewes, and the tendency to provide access to more solid contents. Corner et al. [51] and Akta,s et al. [28] demonstrated that most likely, the reason for this phenomenon is the body fat degradation serving as a source for more milk production in the heavy ewes. Overall, the multiparous ewes were characterized by greater milk production performance and greater feed intake, resulting in a better energy balance, than the primiparous ewes agrees with previous reports in sheep by Morrisey et al. [52] and Piras et al. [53], Cabiddu et al. [54] and Pesántez-Pacheco et al. [37].

Liter size had a highly significant effect on lamb growth rate, and it was slightly higher in single compared with twins at birth and subsequent growth rate up to weaning. This result agreed with Bela and Haile [22]; Lamesegn et al. [55]; Gemiyo et al. [36] and Dafur and Mbap [56] who stated that single lambs had higher daily growth rate than multiple born lambs. Also agreed with Yiheyis et al. [35] who demonstrated that the birth type effect diminished at two- and three-month's age. This might be because, after some days' multiple born lambs may be able to get enough milk from their dams because of increased intensity of suckling. Generally, differences in growth rates between singles and twins are mainly due to the level of nutrition they are subjected to during the preweaning period, this specifically refers to the ewe's milk - producing ability as affected by number of lambs suckled and the vigour of the individual lambs as earlier observed.

Several researchers [15,36,48,50,55,57] have shown that male lambs grow faster than female Iambs before weaning. The present study confirms these findings and indicates that part of the advantage of male lambs in preweaning weight gains results from the larger birth weights of males. Thus, heavier lambs at birth indicate rapid growth rates which are expressed prenatally, and which result in faster growth rates. Or may be due to hormonal and environmental causes male lambs were heavier than female. It has been attributed that the growth superiority of male lambs to higher birth weight and presence of androgens, which play a role in growth. The superiority may also be since males are more aggressive and active than females and may consume more milk and feed. Generally, the growth traits particularly pre-weaning in mammalian are not only influenced by the genetic factors but there

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were other factors such as direct maternal effect and permanent environmental effects [3,58]. These maternal effects reflect mainly the dam's milk production and mothering ability, though effects of the uterine environment. The discrepancies may be due to breed variation and differences in management particularly the age of weaning and due to the weight gains during the early-pre-weaning growth stages, also the variation may be due to small size of experimental animals used in study.

Effect of parity order, birth type and sex of lambs on lambs weaning weight

Weaning weights is crucial and indicates the milking ability of the herds as well as the growth potential of the kids. In this study Ewes' parity has no significant effect (P≥ 0.05) on weaning weight and total weight gain and average daily gain of lambs. Lambs born at second parity gained more (87.23g) than third and first parity lambs which gains (86.85 vs. 85.72). Differences in parity due to ewe age affected body weights of lambs mainly at early ages, pre-weaning and overall average daily gain. Generally higher parities (3rd and 2nd) attained higher body weights and faster overall average daily gain compared with lower (1st) parity. This study agreed with Benyi et al. [46]; Gbangboche et al. [47]; Aliyari et al. [26]; Akta¸s and Do˘gan [27] and Dafur and Mbap [56] found no significant effect of parity on weaning and pre-weaning growth rate.

Contrary results to these research different authors find significant effects of parity on ewes weaning weight and preweaning gain by [28,48,51,59-61]. It is well known that mothering ability (milk yield) increases with parity, and older ewes are usually larger in body size and produce more milk, which explains the and Hafezianng weights of lambs from older dams and failure of young ewes to provide sufficient nourishment for the growth of fetuses, which in line with Baneh and Hafezian [62]. Birth type had an important impact on the lamb's birth weight and at weaning [33,63]. In the current study weaning weight of single-born lambs (10.23kg) were heavier than twins (9.77 kg) and triplets (8.00 kg). This effect could be attributed mainly because single lambs do not have to compete for nutrients, unlike what happens when multiple lambs were developed. The current finding agrees with reports of Taye et al. [30]; Yiheyis et al. [35]; Korkmaz and Emsen, [41] and Habtegiorgis et al. [9]. Contrary results to these other authors, however, did not observe effect of litter size on weaning weight [2,45,64].

The effect of lamb's birth type was significant (p<0.05) at pre -weaning stage. Singles were heavier at 90 days of age i.e. they maintained their superiority at birth till 90 days. Lambs born as singles had the highest gains, 93.58g, followed by twins, 85.75g, while triplets had the lowest, 73.30g. The differences between singles and twins and twins and triplets, were significant, which matches several studies in different breeds and management systems [9,36,47,54,55] they stated that single lambs exhibited higher average daily gain than twin and triplet lambs at the pre-weaning stage. The significant effect of birth type on the body weight at weaning was because of competition among the multiples than singles for limited amount of milk of the dams. Generally, singles obtain greater body weight and daily gains than more numerous litters. It was observed in other experiments, where single-born lambs showed a significantly greater body weight growth and body weight at weaning in comparison to multiparous litters [48]. According to Somavilla et al. [65], the better daily gains of singletons may be related to the increased availability of milk compared with twins and triplet lambs receiving proportionally less milk they display slower growth to weaning and lighter weaning weights [63,66].

Generally, the variation in pre-weaning growth rate by birth type of lambs could be due to competition for milk of dam in multiple births. A lamb's sex had an important impact on the lambs at weaning, with an advantage of male over female lambs [27,28,50,63]. In the current research weaning weight secured significantly affected by sex of lambs where male had superiority weight (1.33kg) than their female counterparts. A great number of authors have documented this result in sheeps [35]. This result shows that the heavier weight of single over multiple lambs is partly due to the birth weight advantage of single-born lambs. Majority of the findings indicated that male lambs had usually higher pre-weaning growth and grew faster than females. The superiority of male lambs over ewe lambs is by about 8.85 g at pre weaning gain. This might be due to attributed physiological functions, which play a major role in accelerating growth. The current finding results are comparable to Mesfin et al. [57], Lamesegn et al.,[55], Marufa [48], Gemiyo et al., [36], Behrendt et al. [63], Habtegiorgis et al. [9]. The superiority of males on pre-weaning average daily weight gain was apparently might be the result of their superior birth weights [7], thus, heavier lambs at birth indicate rapid growth rates which are expressed prenatally, and which result in faster growth rates. In addition, it might be to males being heavier than female due to testosterone estrogens and progesterone hormone predominate in male and female [4]. Other studies, however, reported contrary results, Asmare et al. [6], Hagan et al. [11] reported that lamb sex has no significant effect weaning weight, and average daily gain from lambing to weaning,

Effect of parity, birth type and sex of lamb on lamb's mortality rate

Various workers have also examined the effects of parity and have reported a curvilinear effect, like that of dam age. However, parity and age of dams are usually highly confounded, and it is therefore difficult to separate these two effects. In this study 1st and 2nd parities born lambs had higher survival rate compared to lamb in 3rd parity that had higher mortality rate. Several researchers have widely documented similar results [51,55,67].

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Lambs born to smaller lambs have lower survival rates compared with lambs born to mature ewes. This might be due to the first and second parity ewes producing enough milk to nurse their lambs. Contrast to those results that parity of ewes did not affect survival and mortality rates match the finding of Khan et al. [14] and Vatankhah and Talebi [68].

The pre-weaning survivability in single born lambs is not different ($p>0.05$) from those of twins and triplets, this agrees with Hatcher et al. [69] and Hagan et al. [11] who reported no difference between the odds of death in twin lambs as against single born lambs. Also, in line with Korkmaz and Emsen [41] he stated that survival rate was lower for triplets 74% compared with twin 845 and single 88%. The high survival rate in single and twin born lambs match the finding of Lamesegn et al. [55] who reported that Single born lambs had higher survival rate than twins (97.06 vs 78.57 %). This might be due to lambs born single being sole user of dam milk and had better body weight during birth. Our findings could be explained by the good care given to dams and their lambs during the pre-weaning stage, which ensures all lambs have equal chance at survival till weaning. Also, the mortality rate of triplet births reached to1.59% which is lower than that reported by Gemiyo et al. [36]. Generally, triplets are lighter at birth than twins or singletons and this has negative consequences for their survival. Therefore, increasing birth weight should be advantageous and increase their survival [70]. In contrast to this study Vatankhah and Talebi [68] reported different results that type of birth affect mortality rate and survival rate and he concluded that animals born as twins have much higher death rates than those born as single mainly due to lower birth weights and lower milk availability per lamb.

The effect of sex was significant, and females survived well than males, single born lambs had consistently higher survival than lambs born as multiples. The current results match the finding of Mengistie et al. [71]; Lamesegn et al., [54]; Hagan et al. [11] and Habtegiorgis et al. [9] who documented those Male lambs had better survival rate than female (96.30 vs 85.71 %). The higher survival rate of male lambs might be attributed to the preferential management of male lambs in terms of feed and medications to guarantee the superiority of rams during ram selection. Contrast Markos [7]; Vatankhah and Talebi [68] and Kutluca and Emsen [41] stated that sex was not affected survivability and mortality rates, with high survival rate for female 86% compared with male as 78% and concluded that male animals have a greater risk of death as compared to females. Obviously, the sample size that used in this experiment for male lambs was larger (49) compared with females (38) which may affect the significance level between male and female lambs. This needs further investigation on the relationship between the sex of lamb and pre-weaning lamb mortality. Generally, increasing the number of lambs born over time will decrease their chances of survival. Thus, improvement of management interventions for multiple-born lambs should be paid greater attention. This difference might be attributed to different farm management programs. Farm management and particularly feeding programs, have a major effect on certain parameters including birth weight.

Conclusion

Under the conditions of this study, environmental factors (parity number litter size and sex of lamb) have large effects upon lamb growth and preweaning body gain and survival and mortality rates. However, their importance is reduced if the differences due to birth weight are removed. Birth weight has a large effect upon rate of loss, with a curvilinear relationship between weight and the rate of lamb mortality. These results have practical implications not only for the husbandry of the sheep as an economical commodity, but also for the increased knowledge of factors that significantly influence variation in growth traits in Desert sheep in North Kordofan, Sudan and should be considered in the development of sound strategies to raise production.

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