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Dam breed effect and other dam related non-genetic factors as determinants of growth traits in goats and sheep production

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A B S T R A C T

Ewes/does individual performance is a prime factor that influence the overall meat productivity and profitability in goat and sheep production. The number of kids/lambs born per ewe/doe per year, effectively weaned and marketed at a desirable weight are absolutely essential components for the viability of any commercial goat and sheep enterprise. Hence one principal source of substantial meat production inefficiency in commercial goat and sheep production is poor maternal effects which compromise high kid/lamb growth, where a larger proportion of kid/lamb crop fails to attain desirable marketable weight resulting in immense economic losses. There is apparent evidence accrued through extensive studies in goats and sheep which point to the fact that heredity of the dam and other dam related non-genetic factors such as parity order, dam nutrition, age and weight of dam at kidding/lambing and the dam's body condition score influence kid/lamb pre-weaning growth trait and the actual weight at weaning. In this respect, birth weight, pre and post weaning weight gain of kids/lambs may vary with dams' genotype, parity, dams' nutrition, litter size as a dams' trait, dam weight/age and parity order. The resultant effect of genotype of dam on kid/lamb growth can be direct or indirect, firstly there is a direct contribution of half of the dams' genes to the progeny for potential growth of kids/lambs, and secondly the indirect effect comes from dam possessing genes for milk production enough to adequately nurse their kids/lambs hence promoting desirable growth. It is important to note that dam milking capacity is dependent on breed, in addition to being influenced by other environmental factors such as dam nutrition and parity order. Kid/lamb born to high milk producing dams are highly likely to outclass their counterparts in post weaning growth weight gain, as well as the actual weaning weight. Low birth weight kid/lamb are associated with poor nutrition of dams during pregnancy and its effects could be seriously felt in multiple birth which result in compromised post weaning growth. Genetics is a primary source of variation for prolificacy in goats and sheep hence litter size can be designated as a maternal trait. The higher the size of birth the lower the weaning weight because of nursing competition due to multiple birth in large litter size. Mature dams give birth to heavier kids and provide enough milk to nursed kids/lambs promoting faster growth rates subsequently enhancing survivability of kids/lambs. There is potentiality of manipulation of husbandry practices focusing on ensuring that all born kids/lambs are as close as possible to the acceptable birth weight average for that specific breed of choice which can sustain desirable weaning and post weaning growth. It should be noted that due to multifaceted nature of the dam determinants of growth traits it is reasonable to assume that appreciation of specific cause and occurrence of kids'/lamb growth could be advantageous to minimize retarded growth rates. A total control of kid/lamb growth is probably unachievable as a result partly targeting the control of both environmental and dam-related factors is critical. High kid/lamb growth rates necessitate for good management practices and improved dam nutrition to support nursing of multiple birth, in addition to the exploitation of crossbred's heterosis to promote growth in kids/lambs. The present review gives an insight on the influence of dam related factors on pre and post-weaning growth, as well as actual weaning weight in goat and sheep production.

1. Introduction

The growth traits are major determinants of meat production efficiency in goat and sheep enterprises, against this background animal breeder have targeted them for selection in order to improve overall meat production. There is a plethora of studies that have documented sizeable maternal influence for growth traits in sheep (Nasholm, 2004; Hassen et al., 2003; Van Vleck et al., 2003). It has been demonstrated that growths traits in small ruminants are dependent on direct and maternal genetic effects along with non-genetic factors (Assan and Makuza, 2005; Assan et al., 2002). Various authors have studied the influence of maternal effects in relation to their economic importance in domestic mammals and from the theoretical academic interest (Willham, 1972) and dam breed effects were significant and considerable on weaning weight (Eltawil et al., 1970; Karihaloo and Combs, 1971; Sidwell et al., 1964; Veseley and Peters, 1972). From the ewe/does' aspect, maternal influence on progeny growth performance result from maternal characters determined by her genotype and related non-genetic factors. Accordingly, these determinants are divided into genetic and environmental components. However, from the progeny perspective, maternal influences are mirrored as non-genetic (Szwaczkowski et al., 2006). Maternal genetic effects are designate as any influence from dam to progeny, excluding the effects of directly transmitted genes and high growth potential is adversely affected by unfavourable environmental factors exclusive of animals with poor growth capability (Přibyl et al., 2008). Elsewhere, studying different genotypes observed that the influence on early growth in animals aside from the genes of the individual for growth and by the environment in which it is reared, but also by the maternal(dam) genetic composition and environment supplied by the dam (Ghafouri et al., 2008). The maternal components determinant mechanism on growth parameters is confounded in genotype of dam with the parity order, age and weight of the dam, dam nutrition and dam's body condition score. Parity order, age and weight of dam at kidding/lambing, dam nutrition and body condition score have been implicated as important factors that influence pre and post weaning growth performance in kids/lambs and related weaning weight. The early stages of the lamb's life are predominantly dependent on the dam's milk (Van der Linden et al., 2010), hence during this phase maternal ability has a major role to play in influencing lamb development and productivity. This on the backdrop that dam's milking capacity is determined by nutrition, and ewe's genotype (Hamad and El-Moghazy, 2015). A number of studies have observed that lamb growth to weaning is dependent on milk intake (Miguel et al., 2011; Mohammadi et al., 2010), especial elevating the dietary energy intake of ewes during lactation will enhance ewe milk production accompanied by lamb growth (Rao and Notter, 2000). The efficiency of lamb production is affected by reproduction, mothering ability and milk production of the ewes, and growth rate and survival rate of the lambs (Mishra et al., 2007; Gavojdian et al., 2013). This result was confirmed in previous studies by Inyangala et al. (1990) and Gebrelul et al. (1994) who observed that parity and dam age were significant sources of variation for growth rate of goats. Ikwuegbu et al. (1995) working with African Dwarf under smallholder farming condition, demonstrated that the rate of gain and body weight up to weaning was determined by dam age, parity and birth type. A similar report was given by Osinowo et al. (1992) who also proved that pre-weaning average daily gain was influenced by parity. The present review will give an insight on the influence of dam related factors on pre and post-weaning growth, as well as weaning weight in goat and sheep production.

2. Effect of dam genotype on growth parameters in kids/lambs

Dam breed effects were significant and considerable on weaning weight (Eltawil et al., 1970; Karihaloo and Combs, 1971; Sidwell et al., 1964; Veseley and Peters, 1972). The genotype of the ewe was a source of variation on the number of lambs weaned and the survival rate at all stages of growth, but no effect on the number of ewes that lambed was reported (Kuchtík and Dobe, 2006). Comparing productivity between Boer and Kacang goat dam, Elieser et al. (2012) observed that one of the sources of variation on total birth weights of goats is the mature size of the sire and dam. Both Dam reproduction and productivity rates of Boer were superior than Kacang goat breed. More often than not, the offspring of large breeds grows faster as compared to the offspring of small breeds. In their study sire and dam effect caused variation in total weaning weight of the Boer goat that was heavier against Kacang breed. A significant effect of breed type on birth weight has also been reported by Dhanda et al. (2003). In a crossing breeding study, Anous and Mourad (1993) crosses of Alpines with Rove does produced considerably more prolific does and imparting faster growing weaned kids which yielded carcasses that were wider and more compact, and had more internal fat depots. Crossbred ewes produced significantly more lambs compared with purebred ewes. This could be explained through the higher prolificacy of the pure Romanov breed (Turkyilmaz, 2013). In a similar study, Tumele and Dorper x Tumele sheep were not quite as much prolific, nonetheless possessed good mothering ability requisite to effectively raising lambs to weaning age (Tesema et al., 2020). These results were in agreement with those of Gootwine and Goot (1996) for Awassi, East Friesian and their crossbred ewes, of Esenbuga and Dayioglu (2002a) for Awassi and Morkaraman, and of Kremer et al. (2010) for Corriedale and Friesian x Corriedale crossbred ewes. The discrepancy was also explained by the fact that ewe lambs were lighter and had lower body condition scores as compared to mature ewes (Corner et al., 2013). The genotypes of sire and dam were a source of variation total litter birth weight and average litter birth weight (Tsukahara et al., 2008). Magnitude of crossbreeding values indicated negative influence of paternal heterosis on total litter weight and average litter birth weight, meanwhile paternal heterosis effect on litter size was not important. However, South African Mutton Merino and East Friesian sheep were deemed optimal sire breeds for the litter size and might bring the greatest economic benefit in imported populations, while Suffolk features well as a sire breeds in improving ADG (Di et al., 2012). Kenyon et al. (2007) reported that dams with a high IGF-1 genotype could enhance the growth of their lambs from birth to weaning through higher milk production, however suggested further investigation on the matter. Maternal genotype modulates fetal growth and birth weight in the same way as the genotype of the fetus, maternal nutrition and the external environment, where the weight at birth of the individual lambs was profoundly associated with their mothers' profile (Oldham et al., 2011). Dam breed and dam x location interaction was an important source of variation lambs weaned per ewe mated (Corum et al., 1974). The overall ranking of ewes in this regard was Willamette, Suffolk, and then Hampshire sheep breeds. The interaction was a consequence of an irregular increase in the performance of the Willamette ewes on the hill land, while the Suffolk ewes were superior on the irrigated and/or improved pasture. This pointed to the fact that Willamette ewes had adapted well to hill land during their development and selection. Lambs born to maiden ewes were smaller and underweight at birth (Kenyon et al., 2014; Everett-Hincks et al., 2008), weaning (Loureiro et al., 2011), and to 12-months of age (Pain et al., 2015) and had lower survival rates (Mulvaney, 2011), against lambs born to mature ewes. Singletons born to maiden ewes were deemed lighter as compared with singletons born to mature ewes from birth to 12 months of age, and periodically up until four years of age (Pain et al., 2015). Even though, numbers and weights of lambs at birth and weaning, were comparable and had an equal production efficiency in terms of weight of lamb weaned. Loureiro et al. (2011) demonstrated that for the first year of life, lambs born as singles to mature ewes were superior from birth to weaning, with twin lambs born to mature ewes and single lambs born to ewe lambs being intermediate and comparable to each other, and twin lambs born to ewe lambs were most underweight. A number of studies reported influence of the birth type on lamb performance, to which singletons outclassed the twin birth (Rashidi et al., 2008; Rocha et al., 2009). The insignificant intrauterine competition or competition for food (maternal milk) in single-birth lambs (Barros et al., 2005) is the major reason for their birth advantage. In a different scenario, Dwyer and Lawrence (2000) observed that lamb breed was a major source of variation on lamb activity at birth and play behaviour over the first postnatal days, with Blackface lambs being significantly more active than Suffolk lambs. Lamb sucking behaviour during this period, however, was significantly affected by ewe breed with a higher frequency of sucking interactions observed with Suffolk ewes. Lambs with Blackface mothers were more active than lambs with Suffolk mothers and this difference persisted after weaning. Maternal effect, accordingly, plays an important role in regulating the behaviour of their progeny in sheep, even though neonatal lamb activity is unaffected by maternal behaviour. Grazing behavior might be important for animal reared under extensive systems, good grazers may have an advantage of growth. It is suggested that the more time kids/lambs can graze the mores feed intake which may equate to nutrient uptake especially when grazing is of high quality. McHugh et al. (2020) reported that dams with a 50% blood of Belclare or Suffolk had a respective 4.19 and 6.92% lower predicted probability of producing ewe lambs who themselves eventually lambed against dams with 25% breed percent of the respective breeds.

3. Effect of age/weight/parity order on growth performance in kids/lambs

The efficiency of pre-weaning growth decreased with the parity/age of dam up to the second parity (Thiruvenkadan et al., 2009) but growth as per gain in body weight per kg of initial weight decreased with advancing age. Dam age and parity were a major source of variation of growth of progeny rangeland goats in Australia. In a similar study, Pym et al. (1982) observed early growth of kids born to maiden does was slow; however, the advantage on early growth did not persist up to until 5 months of age. Weight at birth was enhanced profoundly from the first to third parity, was superior for lambs born as singles as compared with multiples and for male than female lambs (Mavrogenis, 1996) that conforms to the results reported by who observed higher body condition in older ewes, sexual male hormones in ram lambs and higher competition in multiples. Consideration of various environmental factors, essentially the year and the type of birth, the sex of the lamb and the age of the ewe at lambing, is important because they may influence the proper development of the lambs (Carneiro et al., 2007). Pre-weaning traits were observed to be strongly affected by the level of milk production of the ewe and age of dam had a substantially influence on milk production (Bathaei and Leroy, 1994). Age of dam was an important was an important source of variation on the pre-weaning traits Iranian fat-tailed Mehraban breed of sheep (Bathaei and Leroy, 1994). The maiden ewes of one year-old ewes raised lambs were superior growth rates from birth through weaning and were predominantly lighter at weaning, as compared with the other age. Young dams produced lambs with compromised birth weight and weaning weight as compared with ewes in their advanced age in Dorper sheep in intensive production system (Mellado et al., 2016). Post-weaning growth of lambs varied where young ewes (< 20 months) derived lambs lagged in post-weaning with reference to ewes > 20 months of age. This was interpreted by the fact that replacement ewes were still growing hence nutrient partition was spread between muscle development for their own growth and milk synthesis, consequently compromising milk yield necessary for suckling their young ones. The effect of low milk production by maiden ewes/does is predominantly in prolific breeds characterised by multiple birth. Multiple birth might be at a disadvantage than singletons in terms of pre-weaning growth, individual weaning weight as they progress into post weaning growth. As expected maternal instinct and milking capacity tend to be enhanced with greater parity order, and mature ewes are typically larger in body size and their milk yields are higher than maiden ewes. A similar trend has been documented in various sheep breeds utilised in different production conditions (Momany-Shaker et al., 2002; Mohammadi et al., 2010; Rashidi et al., 2008). In different studies age of dam was a major source of variation on weight traits (Wenzhbong et al., 2005; Djemali et al., 1994). Growth traits increased with the age of dam up to 5 years of age, and then decreased in subsequent ages (Djemali et al., 1994). The explanation for dam age effect on the kids weights after 60 days was the large correlation between milking capacity and body size, notably when lower body size is a result of praecox mating (Nadarajah et al., 1995). In addition, age of dam acting essentially by the variation of the dam dairy production which is dependent on the extent of lactations. However, this trend was probably mainly associated with duration of lactation against daily milking capacity. This was illustrated by non-significant effect observed on the weights at birth and at 30 days of age, instead all does are providing the demands of the kids. In a similar study Portolano et al. (2002) also implicated age of dam having a significant effect on the pre and post-weaning growth period between 0 to 15 days of age and between 45 to 60 days of age, respectively, meanwhile the effect was non-existent in the weaning period (between 30 and 45 days old). Post-weaning growth in sheep was not affected by the age of the ewe at lambing. The explanation was that this phase lambs are ahead of time on independency in their feeding, depending more on their genetic potential to their growth than on the maternal effects, especially milk (Souza et al., 2003).

Age of dam has been reported as an important source of variation for early growth traits in a number of studies (Olthoff and Boylan, 1991; Snyman et al., 1995; Esmaeili Zade et al., 2002). The conclusive statement was that effect of dam age was a curve status and was observed between 4 to 6 years of age as an optimal phase. Moreover, BW6 and DGW-6 in lambs from ewes with 3 to 6 years old were superior as compared to other ages (Yazdi et al., 1998; Bathaei, 1994), this was in disagreement with results by Lavvaf et al. (2007) possibly due to inaccuracy in lamb weight and birth date of lamb in data sets. It was needful that only pre-weaning traits would be influence by the age of ewe, as observed in other studies (Rosov and Gootwine, 2013). Mellado et al. (2016) suggested that average weaning weight increased linearly with increased age of dams, this was corresponding to other findings by (Momany-Shaker et al., 2002). Age of dam was a source of variation on the majority of growth traits (Kuchtík and Dobe, 2006). Křížek et al. (1992), Burfening and Carpio (1993) and Macit et al. (2001) reported similar result working with different flocks. The influence of dam age on body weight was also experience at 30, 70 and 100 days of which lambs increased with the increasing age of dams (from 2 to 4 years), however BW 30, BW 70 and BW 100 of lambs originating from five-years-old and older dams were approximately comparable to lambs of three-years-old dams. Elsewhere the highest and the lowest values (269 vs. 229 g) of average daily gain were observed in lambs from four-years-old and two-years-old dams, respectively. In a similar study Analla et al. (1998) and Matika et al. (2003) cited a comparable scenario meanwhile Dixit et al. (2001) observed most improved daily gain from birth to 90 days of age was observed in lambs born from two-years-old dams.

According to Mabrouk et al. (2010) kids born from mature goats were superior at birth however this trend was lost in goats above 8 to 10 years of age. This is probably explaining the decline in maternal influence as dams go older. The reproductive tissue aged dams may have degenerated to properly accommodate conceptus hence the decline in maternal influence. The lower averages of weight at birth especially of young ones born from maiden ewes which are still growing, are explained by the undeveloped reproductive systems and low uterine capacity of these ewes and the likely competition between the fetus and the ewe for nutrients (Souza et al., 2003). Moura Filho et al. (2005) and Mohammadi et al. (2010) maiden ewes are highly likely to wean lambs of low weights as a result of lower milk production. However, provision of supplementation to ewes could offset the mediocre performance of growth of lambs born from younger ewes at pre-weaning. Despite of this Al-Shorepy et al. (2002) did not find any significant effects of the age of dams at kidding for all traits. Parity was equally an important source of variation on weaning weight in various breeds. Vostrey and Milerski (2013) observed that weaned lambs born from three to four year of ewe's age had the highest growth performance. It's reasonable to assume that balancing the proportion of replacement rates between maiden dams and old ones may contribute to exploitation of dams' prolificacy and maximize of kids'/lambs post weaning performance. In terms of nutrition provision of adequate dam nutrition might minimise kid/lamb retarded growth post weaning in small ruminants through its indirect effect on milking capacity to feed its young ones. If nutrition has an influence on kid/lamb post weaning growth, then most poor performance cases should be experienced in late winter meanwhile forage is least available exposing kids to several months of poor-quality forage. This implies seasonal and/or yearly variation of feed resources will definitely affect kid/lamb growth performance. It becomes critical for goat and sheep producers to recognise the nutritional requirement and appropriate management of young and old dams which will improve kid/lamb post weaning performance. Similarly, Chowdhury et al. (2002) for Black Bengal goat, and Al-Najjar et al. (2010) for Shami goats reported that growth performance of young ones was found to be increases linearly with increasing parity or dam age. Greater focus to the management of younger ewe/doe is justifiable to minimise kid/lamb growth failures. Improved nutritional management, particularly ewes/does nursing twins and triplets, is critical to improve growth traits of lambs and kids. Appropriate management intervention at an earlier stage of animal development, the more rapid they will attain the slaughtering conditions and, as a result less expensive the production cost (Mexia et al., 2004; Pacheco and Quirino, 2008). The increase in litter size due to increased dam age has an indirect implication on kid/lamb growth performance and weaning weight due to its effect on compromised birth weight in multiple birth. Haga et al. (2014) noted that the chances of multiple birth increased with increased dam age up to 4 year of age and slightly declined at 5 year of age. One might suggest that age of dams between 4 and 5 years will give the optimum weaning weights, assuming this period coincide with elevated maternal instinct.

Danso et al. (2016) observed that dams live weight, body condition and mating season of the sheep had nominal effects on milk production and weaning growth of twin lambs. As expected mothering ability (milk yield) improves with advanced in parity order, and mature ewes are typically large sized in body weight and have an advantage of producing more milk, which translates to higher weaning weights of lambs from older dams. In a similar study, not only the level of nutrition on offer through lactation, was associated with lamb growth but also live weight change of the ewe during pregnancy (Thompson et al., 2011). This result points to the fact that management of ewe and lamb nutrition is crucial to maximise growth of lambs before and after weaning. With regards to mature size of progeny it seemed not to be adversely affected by pre-weaning nutrition especially taking into account the nutritional provision during pregnancy and lactation that are likely to be considered in intensive systems. It is well recognised that lighter weaners are less able to cope with nutritional or other stresses due to smaller energy stores than heavier weaners (Allden, 1970; Doyle and Egan, 1983) consequently influencing their post growth potential. As expected the discriminatively partitioning of nutrients to milk production as distinguished from body reserves during lactation had a secondary impact of ewe liveweight change during lactation on weaning weight (Morgan et al., 2006). There is a tendency of dams by and large increasing in body weight with progressive age Browning et al. (2011). Its resultant effect is improved lactation on mature does having the capacity to provide adequate milk supply to their young ones, consequentially improved weaning weights and probably post weaning growth. Sound body weight of dam has been associated with higher weaning weights in goats and sheep.

4. Nutrition and body condition score of dam effect on growth performance in kids/lambs

At the early stages of pregnancy nutrient requirements for foetal development are still minimum, but placenta growth is imperative. This implies nutritional restriction to placental tissue will adversely affect foetal development in the pregnancy last trimester phase, hence the end result is a compromised birth weight (Acero-Cameloetal, 2008) and hence depressed weaning weights. Inadequate nutrition will adversely influence weight at birth which translate to subsequent poor growth performance. Pre-weaning phase growth is associated with the milk production of the dam and to the nutritional support as compared to the genotype of the offspring, so the lambs do not express the genotypic variation expected at this stage (Mexia et al., 2004). Fernandes et al. (2001) and Koritiaki et al. (2012) observed that the weight of the ewe at lambing is mostly associated with nutritional status and had a linear effect on the weight of the lambs from birth to weaning. In a similar study, Silva and Araújo (2000) reported a specific linear effect of weight at lambing on weight at birth, but they demonstrated a quadratic effect on weight from 56 to 112 days of age. Lambs weight before weaning is greatly dependent on the dams' milk rather than the genetics (Kashani and Bahari, 2017). Therefore, it is effective to choose a kind of ewe which produces more milk because it may improve weaning weight. The difference in weaning weight in various seasons time is due to the environment factor impact mention like temperature as well as the other factor such as nutrition, disease and management. Meat productivity fits itself as a function of kids'/lambs' potential growth rate during pre and post weaning, and the actual weaning weight as influenced by milking capacity of their dams. This implies that apart from promoting kid/lamb pre-weaning growth rate, milk production capacity of dams will also influence the actual weaning weights and post weaning growth and these determine the targeted slaughter weight. Plane of nutrition for dams will indirectly influence the rate of post-weaning in kids/lambs as there is high correlation starting from birth through weaning up to post weaning growth. Dam nutrition will promote dam milking capacity for feeding young ones as a result enhancing weaning weights and the after effect felt during post weaning phase. In contrary, Greyling et al. (2004) observed that nutrition did not influence birth weight, however the preceding growth was determined by nutritional regime. This was partly in agreement with Bajhau and Kennedy (1990) who demonstrated that maternal nutrition affected the postpartum growth of rangeland kids. In this case, it is reasonably to suggest that birth weight is an important determinant on desirable postpartum growth to weaning. However, it is uncertain to what extent maternal nutrition can influence postpartum growth to weaning, especially in grazing goats. Suspect there should be difference in the effect of maternal nutrition with regards to intensive versus extensive mode of production. Due to intense supplementation of kid/lambs in intensive production systems will obscure the effect of maternal nutrition postpartum to weaning. Genotype might be also a confounding factor because it has been noted that maternal genotype's response to nutrition might differ, hence maternal nutrition influence will be greatly being influenced by the dam genotype. The milking ability is also depended on genotype, hence different breed has been known for their high milking capacity consequently influencing postpartum growth and weaning. Dam genotypes with low milking potential have been assessed based of progeny's postpartum growth and weight, which most of the time are inferior. It has been suggested that knowledge on the effect of maternal nutrition will become handy in goat and sheep management decisions, especially on feeding requirement for grazing ewes/does in late pregnancy.

There is a plethora of studies measuring dams at breeding that have documented a positive relationship between BCS and lamb birth weight (Maurya et al., 2009; Sejian et al., 2009), mid-pregnancy (Everett-Hincks and Dodds, 2007) and the last trimester of pregnancy (Hossamo et al., 1986; Molina et al., 1991). Kenyon et al. (2014) suggested that meanwhile the association between body condition score (BCS) and production traits is positive, it is improbable to be linear. In situation of nutritional inadequacy the repository of disposable nutrients stored in body tissues, for instance adipose tissue and intramuscular fat, can be mobilised by dams in pursuit of equalizing lactation nutritional demands (Rauw, 2008). This is the reason why dams should be in sound body condition score during lactation. The implication for insufficient feeding is that dam will not produce enough milk to sustain growth of their young ones which also has adverse effect on future growth and presumably mature weight. It is common knowledge that nutrient inventory is reduced especially during lactation when the demand for nutrients is immense there is a tendency for dam to draw nutrients from their body reserves in its quest to fulfil their nutrient requirements. The live weight of a dam is a composite of both body size and condition, hence live weight on its own may not exactly be a good index of an animal's body condition (Ducker and Boyd, 1977). It has been noted that a specific liveweight could be a large-framed animal while in run down condition or a smaller-framed animal with desirable body condition. There is a recognized positive relationship between body condition score and live weight of dams, however, there is a conceivable confounding effect between the two factors. The relationship between live weight and body condition score is also dependent on age of dam. As an illustration in Merino ewes with a BCS of 3.0 at day 100 of gestation gave birth to heavier lambs as compared to a BCS of 2.0 at day 100 (Oldham et al., 2011). However, in contrary, Romney ewes with a BCS of 3.5-4.0 at breeding gave birth to lambs lighter as compared to those born to ewes with a BCS of 3.0 at breeding (Kenyon et al., 2004a). Nutritional demand is very critical especially in late pregnancy and becomes even worse for ewes carrying multiple fetuses where the demand increases exceedingly (Nicol and Brookes, 2007). Hence, it is suggested that the repercussions of BCS on fetal growth and lamb birth weight would be pronounced in late pregnancy, especially in circumstances where dam nutrition is restricted. Working with Awassi ewes, Hossamo et al. (1986) reported that the pre-breeding BCS had no influence on lamb growth or weaning weight, meanwhile the same parameter measures at pre-lambing period was a source of variation on both end results important. Alvarez et al. (2007) studying Corriedale ewes, the BCS determined during pre-breeding was associated with twin seldom to singleton lamb growth. A greater reliance on body reserves to meet the metabolic needs for lactation is conceivable in a twin-bearing ewe, which is likely to explain this relationship. Gibb and Treacher (1980) observed that ewe BCS influenced lamb growth, especially in the event ewe intake of herbage was depressed by high stock density. In contrary, when the ewe were supplied with additional nutritional allotment in lactation, the effect of ewe BCS on lamb live weight did not exist (Gibb and Treacher, 1982). There is a positive correlation between dams' milk production and dam body condition score which is enhanced by good nutrition later imparting positive rates in kid/lamb growth. Does/ewes in poor body condition due to inadequate feeding have complications in mobilization of their body reserves to sustain the increasing demand for lactation for kids/lambs. This implies that ewes/does in good body condition due to adequate feeding are likely to produce more milk for the suckling kids/lambs to achieve desirable weaning weight.

Due to nutrient mobilization during lactation the dams body composition changes considerably to a large extent to loss of fat and protein. This has negative effect on the ewes'/does' body weight. Underpinned by plane of nutrition maiden ewes/does produce less milk than older ewes/does and also milk production is influenced by the ewes'/doe's body condition during lactation. Heavier lambs had the superior development efficiency during lactation, determined by dam's milk yield and length of lactation period and also influenced by age and body condition of the ewe at lambing (Ploumi and Emmanouilidis, 1999). This was squarely ascribable to the low breed milking capacity as from the 8th week of lactation (Combellas, 1980). Genotypes' ability to produce sufficient milk for sustaining its young ones might directly influence growth performance in sheep and goats after weaning. This might indirectly also relate to parity order, where milk production will tend to increase as parity order increases hence might have an impact of the performance of weaned kid/lambs. Parity of dam significantly influenced all the production performances, this experience was also observed in other goat (Bagnicka et al., 2007) or sheep (Boujenane, 2002) breeds. This implies that the maternal ability will improve with an increase of parity, for the most part in multiple birth species. Konyal et al. (2007) working with Turkish Saanen goats that the cotyledon increase in number with increase in parity and this also applies to placental weight. It was noted there was a strong association between litter size weight and cotyledon number and placental weight. This result was in conformity with observation in Scottish Blackface and Suffolk sheep (Dwyer et al., 2005). Kaulfuss et al. (2000) reported a maternal compensation mechanism for the raising fetal requirements in dams. As the litter size increases the surface area of the cotyledones for each lamb decreases because the workable placental compensation mechanism collapses. This could be the explanation of compromised weight at birth in large litter size.

Understanding the attributes that influence the drivers milk production is crucial in curtailing low weaning weight in goats and sheep. It will be also sufficing to assume that well fed dams milking ability can counteract the effect of low weaning performance. Despite sufficient pasture availability for foraging, low weaning weight exhibited by poor growth in response to selective grazing strategy by lambs (Poli et al., 2009). Suggestions are that the detrimental effects of suboptimal maternal nutrition during lactation on milking capacity and the indirect kids'/lambs retarded prenatal growth and low weaning weights can be easily corrected through appropriate nutritional modification and intervention enforced during the dam's lactation window. This implies that weight traits apart from being influenced by genetics of the parents and/or it's on genes, growth traits are also dependent on maternal behavior, especially in provision of sufficient milk which influenced by dam nutrition regime, and also sometimes dam parity order. In a situation where nutrition is inadequate dams will mobilize energy from their body reserves which constitutes a significant portion to the energetic cost of milk production in initial stages of lactation through distinct metabolic transformation. It has been acknowledged that nutrient mobilization for milk production causes a discord between dams' nutritional requirements and its nursing kids/lambs, mainly over the proportion of milk each kid/lamb consume, especially in multiple birth. This conform to the notion that nutrient requirement in terms of energy and protein for milk synthesis can be met by both dietary intake and body reserve mobilization. Suboptimal nutrition during the initial phase of lactation induces a negative energy balance because the maintenance and milk production energy demands are not met. The level of feeding provided during lactation had major implications for lamb growth to weaning and weaning weight (Thompson et al., 2011). This was in agreement with observations by Coop et al. (1972) and Gibb and Treacher (1982), notwithstanding the liveweight amendment of the ewe during pregnancy which seemed to be the emerging most important determinant on weaning weight with reference to changes in ewe liveweight during lactation. Therefore, it is reasonably to suggest that growth traits at different phase of pre and post weaning, and at weaning is an indicative of cumulative effects of maternal nutrition during pregnancy and lactation, in spite of influence on varying nutrition during lactation are anticipated to be outstanding as compared to those as a result of varying nutrition during pregnancy. Inappropriate feeding might pose a lot of challenges for both the kids/lambs and ewes/does as individuals, in the sense that kid/lamb's growth might be compromised and poor nutrition during pregnancy may adversely affect overall birth weights of progeny, in addition to poorly fed dams are prone to low milk production that influence growth during nursing of offspring, especially in multiple birth. Numerous factors impact both pre- and post-weaning growth and kid/lambs with low individual birth weight has an increased risk of poor performance throughout all phases of production. Underweight kids/lambs due to multiple birth demonstrated to consume less milk and colostrum due to being at a competitive disadvantage and often have reduced pre-weaning growth. Larger sized birth can effectively stimulate and drain teats and then accessing more nutrients from their respective teats and as a consequence of variation light and heavy birth weight kids/lambs are often maintained or increased during lactation. Underweight birth is more likely to perform poorly at weaning subsequently less likely to reach desirable slaughter weights. It should be noted that underweight birth kid/lambs require a higher level of management and slow down production throughout the nursing and finishing phases, while reducing value and profitability for producers.

Pre and post-weaning growth performance indirectly is influence by the age of the dam, this maternal effects tend to increase up to a certain point then reaching some plateau and then decline with advanced age. The optimal performance with progressive growth phases will be determined by other factors such as management and nutrition. Weaning weight differed with dam age group where minimum weaning rate was experienced in lambs from dams with 2 and 6 years of age and maximum weaning rates reported in lambs from ewes with 4 years of age. The results indicate that the growth traits between the classes of dam age was different which entails that age of dam is one of the important components affecting the kids' growth parameters. There a conspicuous interaction of age of dam and birth rank on the ewe's live weights, with twins born to ewe lambs having additive effects on their live weight. Lambs born to ewe lambs are underweight against lambs born to mature ewes, considering the maternal deterrent of body size of the ewe lambs. This is a consequence of the maturity of the ewe lamb, which are actively growing to mature size meanwhile pregnant, and has varied nutrient demand against an adult ewe, who is ceased growing (Gardner et al., 2007). Older ewes/does due to their advanced maternal instinct tend to produce large litter with low birth weight hence promoting growth in their young ones. There is a tendency of low birth weight in larger litter resulting into compromised weaning and post weaning growth performance. This explanation is that there is improved maternal instinct and reproductive efficiency as the dams age progresses or mature. In a similar study, Levasseur and Thibault (1980) observed that despite the average litter size of ewe lambs is much lower than of mature ewes, the both growth and mortality rate of their lambs is relatively higher. This was attributable to low maternal instinct in replacement young ewes which are less likely to take care of their young ones promptly, leading to starvation and hypothermia. The low capacity to produce milk due to an under developed udder and probably body condition of young mothers, immature does may not produce adequate milk for nursing kids/lambs hence low performance. On the other hand, as the age of dams progresses it reaches a plateau and then dams start to give low birth weight kid/lams hence increasing kids'/lambs weaning weights and even post-weaning growth from aged ewes/does.

5. Implications for goat and sheep production

Dam influence on growth traits is two pronged as direct and indirect effect; dam contribute half of the genes for potential growth, apart from its own genes for milk production to produce enough milk to sustain growth in kids/lambs. The explained variation in dam milking potential is due to breed differences in milk genes. Kids'/lambs' potential growth rate and the actual weaning weight are to a larger degree influenced by milking capacity of their dams, where higher body measurements at initial phases of growth due to dam milk capacity will perform better with respect to even body weight traits at later stages of growth. Targeted use of certain dam breed due to their milking potential can have a considerable economic impact much more than merely improving growth rate of kids/lambs. Therefore, utilizing highly prolific and precocious goat/sheep breeds, in crossbreeding will improve reproduction traits in terms of the number of lambs born and weaned.

To augment the genetic potential of dam milking capacity, provision of adequate and quality of feeding has been the major driver of high dam milking capacity which translate into improved growth traits of kid/lamb. Therefore, meeting the acceptable dams' nutritional requirements is critical, especially during pregnancy in order to influence birth size, and during lactation to directly promote production of enough milk which is essential for optimal weaning weights.

Pre and post-weaning growth performance indirectly is influence by the age of the dam, hence this maternal effect tends to increase up to a certain point then reaching a plateau and then decline with advanced age, however this effect is confounded by parity order where high parity order have improved mothering ability associated with nursing kids/lambs to higher weaning weights. As expected mothering ability (milk yield) improves with advances in parity order, and mature ewes are typically large sized in body weight and have an advantage of producing more milk, which translates to higher weaning weights of kids/lambs from older dams.

Dam in good body condition score at kidding//lambing mostly due to adequate feeding tend to drop kids/lambs of desirable birth weights and hence likely to grow faster prior weaning. The dams influence on size of birth has also a bearing on subsequent post weaning growth and mature/slaughter weight. Maiden ewes/dams tend to drop kids/lambs of compromised birth weight than mature ewes/does due to undeveloped reproductive systems. Kids/lambs that are heavier at birth are worth more money because they are likely to be heavier at slaughter weight. Low birth weight due to multiple birth has been implicated as one of the primary cause of low weaning weights and poor results on post weaning growth performance in goats and sheep. Maiden ewes/does tend to wean lighter kids/lambs because they produce less milk to promote growth in their young ones as compared with mature ewes/does.

Parity of ewes/does is a source of variation for kid/lamb pre-weaning growth and subsequent growth phases of production, with kid/lambs born to primiparous ewes/does having a growth disadvantage. High parity order ewes/does, due to significantly developed udder glandular tissues, as a result of consecutive suckling produces more milk than low parity order does consequently improves growth traits in kids/lambs.

One of the appropriate approaches to improving weaning weight in goat/sheep meat production is to select replacement ewes/does from dams with good maternal abilities has been positively associated with parity order. Hence, targeting maternal behavior traits for selection is highly likely to contribute to improved kid/lambs growth rate as a result influencing undoubtedly the weight at weaning and final market weight. The variation in growth traits may be explained partly by genotype differences in maternal ability. Goat/sheep producers should further evaluate kids/lambs birth having the lowest weights at birth and/or multiple birth and consider different alternatives for managing underweight or multiple birth kids/lambs on an individual herd basis.

6. Management consideration

Producers should synchronise flock birth schedule to convenient times in order for birth activities to commence after forage growth has well started, ensuring that ewes/does receive quality forage during late pregnancy to optimize fetal growth and later colostrum production for kids/lambs. Provision of optimum ewe nutritional management is critical in order to improve kid/lambs prenatal growth, especially for both energy and protein as well as micronutrient (vitamins and minerals) as it is central to determining size at birth and colostrum production. On the other hand, optimal nutritional provision to ewe/does during lactation is important in enhancing weaning weight which cascade to post weaning and possibly mature size. Crossing breeding apart from improving growth traits in kids/lambs, can also improve maternal traits in F1 ewes/does.

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