Carcass characteristics of Dorper ram lambs weaned at different ages

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Abstract

Two aspects that are always considered as emphasis in farm production are body weight of live animals and their carcass characteristics. The carcass characteristic determines the market price of meat and carcass yield affects the farm profit. The carcass characteristics of Dorper ram lambs weaned at different ages were evaluated at similar slaughter age of 270 d. A total of 27 newborn Dorper ram lambs were selected randomly and divided into three groups of 9 animals each. Animals in groups 1, 2 and 3 were weaned at 30, 60 and 90 d, respectively. Group 3 served as a control group based on the current weaning practice. Creep feed containing 18% CP and 12 MJ/kg ME was provided to the respective groups of lambs at 3.5% of the animal mean body weight before weaning followed by grower feed containing 14% CP and 10 MJ/kg ME after weaning at 3.5% of the animal mean body weight. The average live weight of groups 1, 2 and 3 before slaughter were 42.17±8.01 kg, 43.83±3.33 kg and 45.00±6.25 kg, respectively. However, the mean weight was not significantly different among the treatment groups. The cost of production of groups 1, 2 and 3 were RM1.35, RM1.15 and RM1.57, respectively. Compensatory growth from not getting the dam's milk showed that group 1 ate more feed given to them compared to group 2 but less than group 3. The different ages at weaning did not influence carcass yield (live weight, carcass weight, carcass length, dressing percentage, meat weight, bone weight and meat to bone ratio) or body composition (organs and fat) of Dorper ram lambs. From this experiment, the cost of production was minimal when the animals were weaned at 60 d because the mortality was highest when the animals were weaned at 30 d. Therefore, it is concluded that Dorper sheep can be weaned as early as 60 d of age to maximize farm profit.

Keywords: Dorper sheep, weaning ages, body weight, carcass yield

Introduction

In Malaysia, local mutton consumption increased by almost 30% from 19,309 tonnes in 2009 to 43,703 tonnes in 2014. However, this had not reflected in the population of sheep (*Ovis aries*) which only increased by about 3% from 136,285 heads in 2009 to 139,670 heads in 2014 (Deparment of Veterinary Services, 2015). The increased demand for meat was partially realized by the importation of live sheep, whereby 34,554 heads of live sheep were imported in 2014 compared to 20,187 in 2009. Imports of mutton were 18,400 tonnes in 2009 and 27,248 tonnes in 2014 which was almost an increase of 48%. In the livestock industry, the productivity of a particular breed, especially with regards to its capability to reach the desired market weight is very important for any producer to maximize profit. Nagpal *et al.* (1995) reported that the cost of production per unit of body weight gain was minimum for early weaned kids under semi intensive system and maximum for late weaned kids fed intensively. An earlier study however reported 20% lower production cost through weaning at earlier age (Fehr *et al.*, 1976). Early weaned lambs can be marketed earlier as compared to the late weaned lambs due to its tendency to reach market weight earlier and grow faster, thus gaining more profit in terms of overall production. Through early weaning of lambs, the subsequent production cycle can be continuously implemented. However, early weaning of lambs has always been linked to high mortality, if the activities were carried out unstrategically and without proper planning (Memiši *et al.*, 2009).

Sayed and Mehdi (2017) observed that lambs weaned at 75 d showed higher feed intake and daily weight gain compared to lambs weaned at 45 and 60 d. In Egypt, Barki lambs were weaned as early as 60 d due to their physiological capability to use solid diets (Hashem *et al.*, 2013). According to Miroslav *et al.* (2015), the carcasses of early weaned Blackhead Pleven lambs displayed a tendency towards higher fattiness and more internal fat.

Two major aspects normally used in carcass assessment are carcass yield and carcass quality. Carcass yield refers to dressing percentage while carcass quality involves visual assessment of shape (conformation), fat coverage, age (slaughter age), texture (firmness, tenderness, and juiciness), pH and colour (Getahun, 2001). Dressing percentage is the potential yield of meat from an animal which is calculated by dividing the carcass weight (hot carcass) to the live weight. The hot carcass weight refers to the weight taken after skinning and evisceration and before chilling. The chilling process is the removal of heat and moisture from the carcass. The shrinkage from carcass due to chilling is between 3-5% of the initial hot carcass weight (McMillin, 2010) with a range between 1.5–2% of the initial carcass weight (Warriss, 2000).

Schoenian (2009) reported that dressing percentage (DP) for a goat is affected by many factors, including sex, age, gut fill, and fat content. Meanwhile, Sayed (2009) explained DP increased with increase in fattiness and this is associated with feeding high dietary energy. The average DP of goats is between 42–48%. Carcasses with more internal or external fat have higher DP, so carcasses from older goats usually have slightly higher DP than kids unless the older animals are culled breeding stock that are very thin (Wildeus *et al.*, 2007a). Sanudo *et al.* (2010) reported that shrinkage loss for unweaned ram lambs was lower than weaned ram lambs. Carcasses from weaned lambs were visually assessed to have less fat than unweaned lambs. These results were in agreement with those of Summers *et al.*, (1978) who found that unweaned animals were fatter than weaned animals. Unweaned lambs had higher dressing percentage than weaned lambs probably because of differences in fattiness (Lee *et al.*, 1990) and a possible lower development of the gastrointestinal tract and its contents as is usual in suckling animals. Plasma free fatty acid concentration increased in early weaned lambs due to lipid mobilization (Vernon, 1980; Bozzolo *et al*, 1990) and milk fat breakdown. During the adaptation to the completely dry diet and following weaning, there is a new lipogenic period with the formation of triglycerides with a higher proportion of unsaturated fatty acids (Bozzolo *et al.*, 1990). Busboom *et al.* (1981) reported that differences in these polyunsaturated fatty acids are only noticeable when the differences in energy and protein are significant. This study was designed to assess the carcass characteristics of 9 mo-old Dorper ram lambs weaned at 30, 60 and 90 d of age.

Materials and Methods

Experimental animals

A total of 27 Dorper ram lambs were obtained from MARDI Research Station, Muadzam Shah, Pahang and used for this experiment. The completely randomized designed experiment was conducted at MARDI Research Station, 26700 Muadzam Shah, Pahang. All lambs were ear tagged, weighed and the dates of birth were recorded. All lambs were allocated randomly based on birth weight (average weight 3.06±0.74 kg) into three experimental groups. The three treatment groups were Groups 1 (G1), 2 (G2), and 3 (G3) for lambs weaned at 30, 60 and 90 d, respectively. During the pre-weaning stage, a formulated creep feed was fed to the three groups. After 90 d, all lambs were fed a common grower feed until the age of 270 d.

Housing

All lambs in this experiment were housed in 3 different pens, each occupying 9 animals for Groups 1, 2 and 3. The pen had square mesh floor of 2cm x 2cm with approximately 17.65 sq m pen space fitted with a feeder and a drinker.

Feed formulation

The creep and grower feed were formulated as shown in Table 1 and Table 2, respectively. The creep feed was formulated to contain 12 MJ/kg metabolisable energy (ME) and 18% crude protein (CP) whereas the grower feed 10 MJ/kg ME and 14% CP. The analysed nutrient content of both feeds is shown in Table 3. Diets were formulated based on National Research Council (NRC, 2007) recommendations.

Feeding of the animals

Lambs were fed twice daily (0800h and 1500h). Fresh clean water was supplied *ad-libitum* for the duration of this experiment. Each animal was provided a complete feed based on a dry matter intake (DMI) of about 3.5% of the mean body weight per day. The experimental animals were monitored daily by visual assessment to check for signs of sickness. Sick animals received appropriate treatment from the consulting veterinarian and the cause of illness and treatment were recorded.

Table 1. Ingredient and nutrient composition of creep feed (% as fed)

Ingredients	%
Kenaf leaves (*Hibiscus cannabinus* L.)	10.00
Soya bean meal	18.00
Ground maize	64.00
Salt	1.00
Molasses	5.00
Limestone	0.50
Ammonium chloride	0.50
Vit-Mineral premix	1.00
Total	100.00
Nutrient composition[1]	
ME (MJ/kg)	12.00
CP (%)	18.00
CF (%)	5.97
EE (%)	4.01
Ash (%)	5.54
NFE (%)	58.90
TDN (%)	72.00
Ca	0.62
P	0.31

[1]ME: Metabolisable energy (Megajoule/kg); CP: Crude protein; CF: Crude fibre; EE: Ether extract; NFE: Nitrogen free extract; TDN: Total digestible nutrient; Ca: Calcium; P: Phosphorus.

Table 2. Ingredient and nutrient composition of grower feed (% as fed)

Ingredients	%
Soya hull	17.00
Palm kernel cake (PKC)	34.00
Grass hay	12.00
Soya bean	1.00
Ground maize	28.00
Salt	1.00
Molasses	5.00
Limestone	1.00
Ammonium chloride	0.50
Vit-Mineral premix	0.50
Total	100.00

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Ingredients	%
<u>Nutrient composition[1]</u>	
ME (MJ/kg)	10.00
CP (%)	14.00
CF (%)	13.50
EE (%)	3.42
Ash (%)	5.73
NFE (%)	56.90
TDN (%)	67.40
Ca	0.85
P	0.41

[1]ME: Metabolisable energy (Megajoule/kg); CP: Crude protein; CF: Crude fibre; EE: Ether extract; NFE: Nitrogen free extract; TDN: Total digestible nutrient; Ca: Calcium; P: Phosphorus.

Slaughter procedure and carcass analysis

When the animals reached 270 d, 9 lambs (3 per treatment) were slaughtered for carcass analysis. The day before slaughter, all lambs were fasted overnight with access to water *ad-libitum.* Body weights were recorded before Halal slaughter. Following slaughter, the carcass was split along the vertebral column and the left section was used for carcass analysis. Weight of blood, head, feet, skin, tail, stomach with content, intestine with content, liver, lung and trachea, heart, pancreas, spleen, kidneys, esophagus and bladder were recorded during the slaughter process. Data on live weight, carcass weight, carcass length, dressing percentage, meat weight and bone weight were recorded at the end of this experiment.

Economical value

Farmers are always concerned about the cost of production as an indicator to present the farm productivity. Simple calculation was done to evaluate the meat value of the Dorper sheep during this experiment. The meat value was calculated as follows:

Meat value = Meat weight (kg) x RM24/kg

where market price of meat was assumed at RM24/kg.

Statistical analysis

Data were analysed using SPSS statistical software program 16.0 (SPSS Inc., Chicago, IL, USA). Values were expressed as the means±standard deviation. Differences in carcass yield parameters between three treatment groups were evaluated using analysis of variance (ANOVA) and the differences between means separated using Turkey’s test at 5% significance.

Results and Discussion

The live weight before slaughter and the meat to bone ratio had non-significant differences ($P<0.05$) between the treatment groups (Table 3). Live weight before slaughter was numerically higher in group 3 - weaned 90 d (45.00±6.25 kg), followed by group 2 - weaned 60 d (43.83±3.33 kg) and group 1 - weaned 30 d (43.17±8.01 kg). There was no significant difference among the treatment groups for any of the carcass parameters measured.

At slaughter, there was no statistical difference in carcass yield between the three treatment groups. Group 3 displayed a numerically higher live weight compared to the other groups (Table 3). Even though, only 3 over 9 animals were slaughtered at the end of this trial but the variability within group had been minimized by picking them randomly for slaughter. However, the current results are also in agreement with Coates and Penning (2000) that late maturing animals recorded higher live weight than those of early maturing animals at the same energy accretion. Energy levels of the diets can influence the carcass composition, especially total fat, back fat thickness and dressing percentage in cattle, while maturity, marbling, quality grade, rib eye, and kidney, heart and pelvic fat were not affected (Woody *et al.*, 1983).

Table 3. Carcass yield of Dorper ram lambs at 9 months of age (Mean±SD)

	Treatments[1]		
Parameter	G 1	G 2	G 3
Live weight, kg	42.17±8.01^{ns}	43.83±3.33^{ns}	45.00±6.25^{ns}
Carcass weight, kg	19.17±4.65^{ns}	20.63±4.37^{ns}	19.83±2.84^{ns}
Carcass length, cm	82.83±6.05^{ns}	84.00±1.00^{ns}	83.33±10.87^{ns}
Dressing, %	45.14±3.61^{ns}	46.79±6.98^{ns}	44.16±3.23^{ns}
Meat, kg	7.18±1.52^{ns}	7.94±1.39^{ns}	7.65±1.27^{ns}
Bone, kg	1.82±0.37^{ns}	1.86±0.23^{ns}	1.64±0.33^{ns}
Meat to bone ratio	1:0.25±0.01^{ns}	1:0.24±0.06^{ns}	1:0.21±0.01^{ns}

[1]G1: Group 1 (weaned at 30 d), G2: Group 2 (weaned at 60 d), G3: Group 3 (control - weaned at 90 d).
n*s=not significant at P<0.05*.

Dressing percentage (DP) is an important tool for evaluating carcass merit between the sheep breeds (Ruvuna *et al*., 1992). According to Priolo *et al.,* (2002), the difference in DP between intensively and extensively raised lambs could be ascribed to the fully developed digestive tract of lambs reared in extensive conditions. As discussed, digestive tract of group 3 was considered fully developed due to late weaning. In the current study, the DP ranged between 44.16±3.23% to 46.78±6.98% and these results are in agreement with the reported range of 44.62±0.07% to 46.02±0.07% (Noraida *et al.,* 2013). Under feedlot and free range management production system, DP for Dorper sheep was reported as 45.1±0.4% and 42.0±0.4%, respectively (Dransfield *et al.*, 1990). Even though, group 3 was heavier in LW at slaughter, numerically higher DP was found in group 2. Lambs fed concentrate for fattening had greater DP than those lambs allowed to graze lucerne (Fluharty *et al.*, 1999). Murphy *et al.* (1994) also showed that the DP for lambs fed concentrate was greater than for lambs grazing lucerne when slaughtered at the same weight. The fully developed digestive tract along with the thin subcutaneous fat layer found in extensively produced lambs, would lead to a lower DP when compared to intensively produced lambs (Borton *et al.,* 2005).

Meat to bone ratio obtained ranged between 3.94±0.15 to 4.70±0.22. Compared to the current study, Noraida *et al.,* (2013) obtained lower meat to bone ratio which ranged between 2.64 to 3.09.

Table 4 displays the body composition of lambs at 9 months of age. There was no statistical difference among the three treatment groups for all parameters measured. Nevertheless numerical differences were observed where the weight of blood collected immediately after slaughter was greater in group 2 (1.74±0.11kg) as compared to group 1 (1.58±0.38kg) and group 3 (1.63±0.28kg). Similar pattern of data was detected for weight of head, feet, stomach with content, spleen and meat. The lowest weight of head, feet, stomach with content, spleen and meat were obtained from group 1. Group 3 had the heaviest weight of skin, tail, liver, lung and trachea, pancreas, kidneys, bladder and fat whereas group 1 had the lightest weight. The weight of intestine with content and bone were highest in group 2 (2.50±0.35kg and 1.86±0.23kg), followed by group 1 (2.18±0.37kg and 1.82±0.37kg), then group 3 (1.88±0.33kg and 1.64±0.33kg). Group 3 recorded the heaviest weight of heart, gall bladder and oesophagus as compared to groups 1 and 2.

Table 4. Body composition of Dorper at 9 months of age (Mean±SD).

	Treatments[1]		
Parameter	G 1	G 2	G 3
Weight of blood collected, kg	1.58±0.38^{ns}	1.74±0.11^{ns}	1.63±0.28^{ns}
Weight of head, kg	2.36±0.25^{ns}	2.58±0.25^{ns}	2.47±0.18^{ns}
Weight of four feet, kg	1.06±0.04^{ns}	1.11±0.06^{ns}	1.07±0.25^{ns}
Weight of skin, kg	3.28±0.64^{ns}	3.53±0.57^{ns}	3.65±0.15^{ns}
Weight of tail, kg	0.14±0.05^{ns}	0.15±0.05^{ns}	0.16±0.01^{ns}
Weight of stomach with content, kg	6.68±2.00^{ns}	7.73±1.13^{ns}	7.35±1.39^{ns}
Weight of intestine with content, kg	2.18±0.37^{ns}	2.50±0.35^{ns}	1.88±0.33^{ns}
Weight of liver, g	485.14^{ns}±111.43	503.30±42.10^{ns}	570.00±113.83^{ns}
Weight of lung and trachea, g	423.84±70.61^{ns}	465.69±91.76^{ns}	471.55±56.10^{ns}
Weight of heart, g	131.36±16.25^{ns}	128.36±19.13^{ns}	161.27±21.50^{ns}
Weight of pancreas, g	57.13±10.57^{ns}	60.82±2.73^{ns}	79.93±32.62^{ns}
Weight of spleen, g	59.69±11.68^{ns}	69.40±9.64^{ns}	68.29±6.09^{ns}
Weight of 2 kidneys, g	110.35±20.88^{ns}	115.73±7.41^{ns}	120.53±11.04^{ns}
Weight of oesophagus, g	59.30±3.45^{ns}	57.20±14.77^{ns}	70.15±26.38^{ns}
Weight of bladder, g	18.52±3.67^{ns}	23.51±4.22^{ns}	23.83±9.20^{ns}
Weight of gall bladder, g	11.793±5.77^{ns}	10.343±2.93^{ns}	20.29±16.45^{ns}
Weight of meat, kg	7.18±1.52^{ns}	7.94±1.39^{ns}	7.65±1.27^{ns}
Weight of bones, kg	1.82±0.37^{ns}	1.86±0.23^{ns}	1.64±0.33^{ns}
Weight of fat, kg	1.75±0.87^{ns}	1.78±0.62^{ns}	1.85±0.99^{ns}

[1]G1: Group 1 (weaned at 30 d), G2: Group 2 (weaned at 60 d), G3: Group 3 (control - weaned at 90 d).
n*s=not significant at P<0.05*.

Economics of production

As there was no statistical difference in growth and carcass characteristics in Dorper ram lambs weaned at 30, 60 and 90 d, a simple economic evaluation was done to ascertain the benefits of weaning age (Table 5). Growth rate and average daily gain for Dorper ram lambs weaned at 30, 60 and 90 d were shown in Figures 1 and 2. There was no significant difference recorded among the treatment groups.

Table 5. Economic evaluation of weaning age of Dorper ram lambs

Parameter	Treatments[1]		
	G 1	G 2	G 3
Total creep feed (kg/lamb)	0.13±0.03[a]	4.48±0.34[b]	15.23±0.33[c]
Total grower feed (kg/lamb)	160.50±30.50[a]	145.98±11.10[a]	179.20±24.90[a]
Total feed cost (RM/lamb)	233.00±44.20[a]	220.30±16.70[a]	289.17±40.10[a]
Meat value (RM)[2]	172.32±36.50[a]	190.56±33.30[a]	183.60±30.40[a]

[1]G1: Group 1 (weaned at 30 d), G2: Group 2 (weaned at 60 d), G3: Group 3 (control - weaned at 90 d).
Means with different superscripts differ significantly (P<0.05).
[2]Assuming RM 24/kg

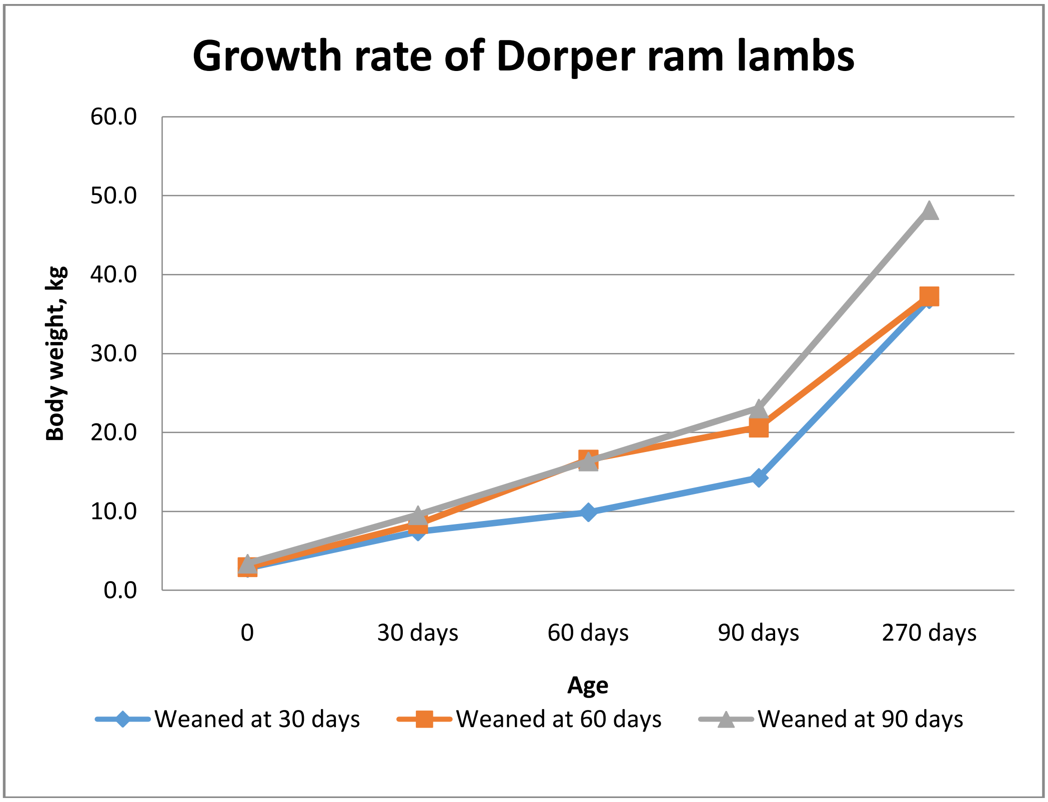

Figure 1. Growth rate of Dorper ram lambs at days 0, 30, 60, 90 and 270

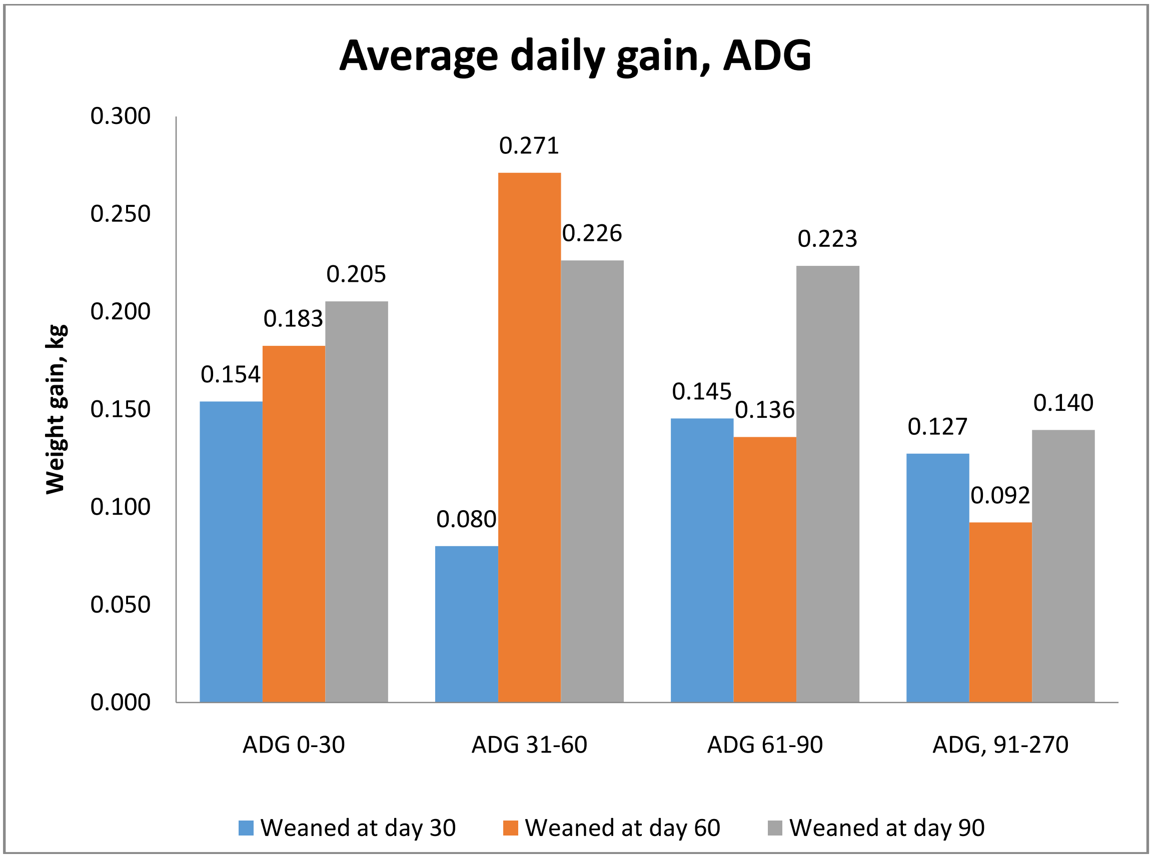

Figure 2. Average daily gain of Dorper ram lambs between days 0-30, 31-60, 61-90, 91-270

Conclusion

As a conclusion, this study shows that carcass yield and body composition of Dorper sheep are not influenced by age of weaning at 30, 60 and 90 days. Through this study, the performance of ram lambs weaned earlier was comparable to late weaned animals. But the highest mortality was recorded when the animals were weaned at 30 d. The market value of the goat meat was highest when the animals were weaned at 60 d, hence a farm can maximize its profit when adopting a 60-d weaning strategy. Therefore, early weaning age can be considered as an approach to maximize the farm profitability.

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