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Effect of Pre-Pubertal Plan of Nutrition on Reproductive Performance, Hormone Concentrations and Milk Production in Kurdish Female Lambs

Research Article

S. Menatian[1*], H.R. Mirzaei Alamouti[1], F. Fatahnia[2] and R. Masoumi[1]

[1] Department of Animal Science, Faculty of Agriculture, University of Zanjan, Zanjan, Iran
[2] Department of Animal Science, Faculty of Agriculture, Ilam University, Ilam, Iran

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*Correspondence E-mail: menatian@znu.ac.ir

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ABSTRACT

To determine the value of pre-pubertal plan of nutrition on reproductive performance, hormonal concentrations and milk production in ewe lambs, a total of 40 clinically health Kurdish female lambs (30±8.6 d and weighing 10.2±3.4 kg) were randomly allocated to one of two experimental diets in pre-weaning period: high quality diet (HQD) (HQD, 2.50 Mcal ME/kg dry matter (DM) and 148 g CP/kg DM) or low quality diet (LQD) (LQD, 2.02 Mcal ME/kg DM and 87 g CP/kg DM). At weaning, one half of lambs from each group was randomly separated and assigned to HQD or LQD. There were four treatment groups in post-weaning period: H-H (HQD pre-and post-weaning); H-L (HQD pre-weaning and LQD post-weaning); L-H (LQD pre-weaning and HQD post-weaning) and L-L (LQD pre and post-weaning, control group). Dry matter intake was measured weekly and body weight (BW) and average daily gain (ADG) were measured every 2 weeks from 30 to 210 d of age. Serum insulin, leptin and progesterone concentrations were determined by ELISA. In general, the HQD treatment increased dry matter intake (DMI), compared with the LQD treatment during pre-weaning period ($P<0.01$). Results showed that initial BW was similar between all experimental groups ($P>0.05$). During post-weaning, lambs of H-H treatment had higher DMI, metabolize energy (ME) and crude protein (CP) intake compared with other lambs treatments ($P>0.05$). Within the post-weaning, serum progesterone concentrations was greater for ewe lambs fed at H-H group than for other groups ($P<0.05$). Serum insulin concentration was affected by the diet quality at both periods ($P<0.05$). Leptin concentration was affected by treatment and ewe lambs of L-H group had higher leptin concentrations ($P<0.05$). Age at the time of puberty was affected by treatments ($P<0.05$). In addition, Ewe lambs in the H-H and L-H groups were younger and weighed more at puberty. Diet plan in the pre-pubertal period was affected milk yield at the first lactation ($P<0.05$). It was concluded that pre-pubertal plan play an important role in secretion of progesterone, insulin and leptin, which can leads to early sexual puberty. And also these strategic plans should be improve economic traits the start of lamb's puberty in sheep husbandry.

KEY WORDS hormone, Kurdish lambs, milk, nutrition plan, reproductive performance.

INTRODUCTION

Reproduction efficiency can plays a critical role in determining profit potential for livestock production systems. Most sheep breeds become sexually active in response to decreasing day length in the late summer to early autumn, which is an additional constraint to the timing of puberty in ewe lambs (Rosa and Bryant, 2003). If a ewe lamb fails to achieve puberty in its first autumn, it will be delayed until the following breeding season (Kenyon *et al.* 2014). Breeding ewes to lamb at one year of age is a potential means of improving farm profitability and ewe lifetime performance by reducing the time interval from birth to first lambing, subsequently reducing feed, labor, housing and other costs associated with raising replacement animals (Young *et al.* 2010; Kenyon *et al.* 2011). Sexual development is an important factor and can be manipulated by altering growth rates (Ettema and Santos, 2004). During the productive life of ewes, puberty period is critical for both animal health and performance. The onset of puberty in sheep is influenced by genetic and environmental factors such as nutrition, day length, temperature and their interaction (Hernandez *et al.* 2011). Ewe lambs growing at faster rates will exhibit their first estrus and are more likely to conceive at a lower age and heavier body weight (BW) than ewe lambs growing at slower rates (Downing and Lees, 1977). Because of the importance of BW, environmental factors that can affect the rate of growth before and after weaning are important determinants of age at puberty. Mulvaney *et al.* (2010) reported that ewe lambs gaining 208 g/d compared to 153 g/d were more likely to return to breeding, although overall pregnancy rates did not differ. Generally, faster growth is associated with enhanced reproductive performance in ewe lambs, i.e. earlier attainment of puberty, more intense estrous activity and higher conception and lambing rates when mated (Dyrmundsson, 1981). The most economically important traits in sheep production are growth, reproductive performance and milk production, and there is no study on above mention characteristic in Kurdish ewe lambs, therefore, the objective of this study was to compare the effects of diet quality fed during the pre-weaning and post-weaning periods and potential interactions between pre- and post-weaning diets on skeletal growth, reproduction performance, hormone concentrations and milk production during first lactation in Kurdish ewe lambs.

MATERIALS AND METHODS

Hormonal drugs

Controlled internal drug release (CIDR) (CIDR, with 300 mg of progesterone), a progestagen analogue (InterAg, Hamilton, New-Zealand), PMSG (folligon; Intervet International B.V., Boxmeer, the Netherlands), oxytocin (Oxytocin V, 10 IU/mL, Phoenix Pharm, Auckland, New Zealand) and commercially available kits leptin (LDN. Germany. LOT: 150873), insulin (DiaMetra. Italy. LOT N: 3949C) and progesterone (DiaMetra. Italy. LOT N: 4026) were used.

Locations, animals and treatment schedule

This study was performed at Nomadic Management Department, Ilam Province, Iran (33 ˚51´ N, 46 ˚27´ E) from January 2013 to December 2015. All procedures involving animal care and management were approved by the University of Zanjan Animal Care Committee (proposal no. 1169739).

A total of 40 clinically health Kurdish female lambs (30±8.6 d and weighing 10.2±3.4 kg) were used. At 30 d of age, lambs were randomly housed together with and twice daily access to their mother milk and were allocated to one of two experimental treatments to achieve either high or low rates of BW gain during two consecutive periods, from 30 to 120 (pre-weaning period) and from 121 to 210 d of age (post-weaning period). They were kept in individual pens (1×2 m) for 3 consecutive days every 2 weeks for recording dry matter intake (DMI). In pre-weaning period the lambs fed high quality diet (HQD) (n=20) or low quality diet (LQD) (n=20) and at the weaning time HQD and LQD fed lambs were re-randomized. So that one half of lambs from each group randomly allocated to HQD or LQD. So there were four treatment groups (n=10) in post-weaning period: HQD pre-and post-weaning (H-H); HQD pre-weaning and LQD post-weaning (H-L); LQD pre- weaning and HQD post-weaning (L-H) and LQD pre-and post-weaning (L-L, control group). The HQD (14.9% CP and 2.50 Mcal/kg DM) and LQD (8.9% CP and 2.02 Mcal/kg DM) were formulated according to NRC (2007) and covered nutrient requirements needs for a 20-kg growing lamb with an average daily gain (ADG) of 200 and 100 g/d, respectively. Rations were totally hand-mixed for each pen and offered in equal proportions twice daily at 09:00 and 16:00 in pre- and post-weaning period. Ingredient and chemical composition of the experimental diets are shown in Table 1.

Estrous synchronization and pregnancy diagnosis

When ewe lambs reached 210-d-old, estrus was induced and synchronized by CIDR. Animals were treated with CIDR for 14 d and were injected with 500 IU PMSG at the time of CIDR withdrawal. Twenty four hours after CIDR withdrawal, all of ewe lambs were monitored for estrus detection by 5 intact fertile rams and were ultimately naturally bred.

The rams remained with the ewe lambs until the termination of estrous signs. After serving, all ewe lambs were kept together in the same nutritional and managerial conditions and reared in the pasture until 2 weeks before expected parturition. Pregnancy diagnosis was determined using trans-abdominal ultrasound (Piemedical, Falco 100; Netherlands) at 60 d after serving.

Data collection and calculation

BW was measured every 2 weeks from 30 to 210 d of age. Feed offered and feed refusals of individual pens were weighed and recorded daily and DM content of total mix ration (TMR) and orts were determined to estimate DMI. ME and CP intake were calculated as DMI from each diet multiplied by their corresponding ME and CP contents.

DM, CP and ether extract (EE) of experimental diets were measured according to the methods of AOAC (1995).

Table 1 Ingredient and chemical composition of experimental diets

Composition (%)	Pre-post-weaning diets	
	HQD	LQD
Alfalfa hay	445.1	-
Wheat straw	-	513.7
Ground barley	445.1	428.1
Soybean meal	59.3	-
Calcium carbonate	5.9	6.8
Salt	5.0	5.0
Mineral and vitamin premix[1]	39.6	46.4
DM	916.0	919.0
CP	148.0	87.0
EE	58.0	22.0
NDF	285.0	450.0
NFC[2]	466.0	371.0
ME (Mcal/kg)	2.50	2.02

[1] Each kg (DM basis) of mineral and vitamin premix contained: Ca: 180 g ; P: 70 g; K: 35 g; Na: 50 g; Cl: 58 g; Mg: 30 g; S: 32 g; Mn: 5 g; Fe: 4 g; Zn: 3 g; Cu: 300 mg; I: 100 mg; Co: 100 mg; Se: 20 mg; vitamin A: 400000 IU; vitamin D_3: 100000 IU and vitamin E: 245 IU.
[2] NFC= 100 - (CP+NDF+EE+ash).
DM: dry Matter; CP: crude Protein; EE: ether extract; NFC: non-fiber carbohydrates; ME: metabolite energy; HQD: high quality diet and LQD: low quality diet.

The neutral detergent fiber (NDF) was measured according to the method described by Van Soest *et al.* (1991) without α-amylase and sodium sulfite and expressed exclusive of residual ash. Non-fibrous carbohydrates (NFC) were calculated according to NRC (2001) dairy cattle model as:

NFC= 100 - (CP+NDF+EE+ash)

Milk intake by ewe lambs was measured by the weigh-suckle-weigh method (WSW) in 3consecutive days every 2 weeks from the start of study to weaning (30-120 d). At the start of WSW method at each suckling occasion (twice daily), ewe lambs were weighed, allowed to suckle the udder of their dams and weighed again immediately after suckling. The difference between pre- and post-suckling weights was defined as milk intake. After lambing, ewe lambs were hand milked twice daily throughout lactation and milk yield was recorded at each milking for the entire lactation (two months; Van der Linden *et al.* 2010). On each milking occasion, ewes were milked by hand after intravenous injection of 1 IU synthetic oxytocin. Milk samples of dams and ewe lambs in subsequent lactation were collected in 3 consecutive days every 2 weeks and analyzed for fat, protein and lactose using Milk-O-Scan 133B (Foss Electric, Hillerod, Denmark). Milk protein, fat and lactose yields were calculated by multiplying milk yield from the respective day by protein, fat and lactose contents of the milk for each ewe. Milk gross energy (GE) according to NRC (2001) was calculated as:

GE= ((0.0547×CP %) + (0.0929×Fat %) + (0.0395×Lactose %))

The mean metabolize ability of the ewe milk GE is 0.94 (Treacher and Caja, 2002), therefore, milk ME content was calculated as:

Milk ME= GE × 0.94

Energy corrected milk (ECM) and fat corrected milk (6.5% FCM) were calculated as:

ECM= (0.327×kg milk) + (12.95×kg fat) + (7.2×kg protein)
FCM= Milk Yield × (0.37+(0.097×Fat %))

Blood sampling and analysis

Before the first meal of the day, blood samples (5 mL) were collected by jugular venipuncture from each lamb every 2 weeks from 90 d of age until puberty (age at puberty was assessed by serum concentrations of progesterone, where puberty was determined as the age when 2 consecutive blood samples contained at least 1 ng of progesterone/mL).

Hence, samples were centrifuged for 15 min (3000 rpm), sera were separated into 1.5 ml micro tubes and then placed in freezer (-20 ˚C). Serum samples were tested for leptin, insulin and progesterone by ELISA method. Standard commercial kits were used for analysis and the procedures were adopted as recommended by the manufacturer of these kits.

Statistical analyses

The data of pre-weaning parameters were subjected to statistical analysis by using of completely randomized design (CRD). The data of post-weaning parameters were analyzed as a completely randomized design in factorial arrangement (2×2) by using of the mixed model procedure of SAS (2003) with fixed effects of treatment and random effects of lamb nested in treatments.

$$Y_{ik} = \mu + D_i + L_k(D_i) + \varepsilon_{ik}$$

Where:
Y_{ij}: dependent variable.
μ: mean.
D_i: fixed effect of dietary treatment i.
$L_k(D_i)$: effect of lamb *k* nested in the dietary treatment.
ε_{ik}: error.

For repeated measure data, model was:

$$Y_{ijk} = \mu + D_i + time_j + D_i \times time_j + L_k(D_i) + \varepsilon_{ijk}$$

Where:
$time_j$: effect of time j as a fixed effect.

Measurements obtained before administration of dietary treatments were used as covariates. The covariates were removed from the model one at a time, starting with the least significant. Least square means, standard error of means, and P-values are reported. Statistical differences were considered significant when (P<0.05) and trends are discussed when (P<0.01).

RESULTS AND DISCUSSION

Kurdish ewe is the most popular indigenous dual-purpose (meat and milk) breed of sheep in west of Iran. Its main characteristics are high meat yield and high prolificacy and high milk yield.

Considering the high genetic potential of Kurdish sheep it is important to ensure that appropriate management practices are implemented in these intensive production systems.

Intake, growth and puberty

Discussing about the topic of sheep and lambs management over the last 40-50 years traditionally involved sheep management, growth development and early weaning. In the last 10-20 years, the concept of "intensified feeding or accelerated growth" has become a focus of discussion and during that time the concept has been applied to research programs and on farm in various ways.

The results of intake and BW that were obtained from ewe lambs pre-post weaning are summarized in Table 2. Results showed that initial BW was similar between all experimental groups (P>0.05), but ewe lambs fed the HQD would gain faster than ewe lambs fed the LQD in BW. And also accelerated BW during the pre-pubertal period was achieved in the current study with affecting age of puberty (Table 3); this is in agreement with the results of Rosales Nieto *et al.* (2013) in ewe lambs. BW includes muscle and fat and thus questions interpretation. An important consideration is that BW per se is simply mass and so encompasses physiological or mechanistic process that would affect reproductive system (Daniel *et al.* 2013). Kenyon *et al.* (2009) and Kenyon *et al.* (2010), indicated that there is a clear positive relationship between BW and reproductive performance in ewe lambs, that a line with the results of present studies.

Results revealed that the HQD treatment increased DMI, compared with the LQD treatment during pre-weaning period (P<0.01). DMI in L-H group was lower than H-H group, which is similar to the observations by Aguerre *et al.* (2013).

DMI in H-L group was greater than L-L group, lambs fed the HQD in pre-weaning had greater DMI when they were fed the LQD in post-weaning, and it seems that increase in DMI let to larger body size. Ewe lambs from the H-L treatments also experienced reduced growth rates during post-weaning period, possibly reason for this result of may be the larger body size, higher basal metabolism, higher energy and protein requirements, with regard to rumen capacity and appetite of lambs the LQD could not cover their needs at period post-weaning. Animals of L-H treatment could respond to diet quality changes but with lower rates than before weaning. Feeding LQD diet reduces the weight gain of growing animals, can result in greater growth rate once dietary conditions improve and current results are in agreement with those reported by Drouillard *et al.* (1991).

Ewe lambs fresh milk intake and milk ME and CP intake were not affected by diet quality among treatments (P>0.05, Table 2). During post-weaning period lambs of H-H treatment had higher (P<0.01; Table 2) DMI, ME and CP intake compared with other lambs treatments (P>0.05).

The rates of ADG was showed in Table 2, indicate differences in the timing of responses to diet quality. Hence, responses to HQD were much greater at a younger age, while responses to HQD were greater for ewe lambs that fed with LQD at pre-weaning then received HQD at post-weaning, which is in agreement with other studies on sheep and cattle (Drouillard *et al.* 1991; Abouheif *et al.* 2013; Yang *et al.* 2014). These authors indicating that increased severity of feed restriction is likely to increase the rate of growth after realimentation. Animals fed HQD had higher BW and ADG compared with animals fed LQD at pre-weaning period (P<0.01). Lambs on the L-H group during the post-weaning had higher ADG than lambs on H-L and L-L groups (P<0.01). However, lambs had higher ADG than H-H group but this difference was not significant (153 *vs.* 138 g/d).

Growth rate and feed conversion ratio (FCR) are considered key production parameters by sheep farmers. Optimizing these parameters can betterment farm income by improving the production of the farm and / or by improving production efficiency (lambs produced per unit of feed consumed).

Lambs consuming the HQD diet in pre-weaning had similar FCR with lambs fed the LQD diet. Ewe lambs consuming the HQD in pre-weaning and LQD in post-weaning (H-L group) had greater FCR than other groups (Table 2). Ewe lambs in L-H group had lowest FCR and greater feed efficiency even compared to H-H group.

Nutrition is a factor influences the start of lamb's puberty and has an important effect on sexual maturity (Hernandez *et al.* 2011).

Table 2 Effect of pre-post-weaning diet quality on intake and body weight of ewe lambs (30-210 d of age)

Item	Pre-weaning treatments		Item	Post-weaning treatments			
	HQD	LQD		HQD		LQD	
				H-H	H-L	L-H	L-L
n	20	20	n	10	10	10	10
Intake			**Intake**				
DM (kg/d)	0.97	0.64	DM (kg/d)	1.54	1.21	1.31	0.87
Fresh milk (kg/d)	1.11	1.18	ME (Mcal/d)	3.85	2.42	3.27	1.76
ME (diet+milk, Mcal/d)	3.49	2.44	CP (g/d)	228	104	194	76
CP (diet+milk, g/d)	187.4	103	Puberty age (d)	123	254	168	267
BW			**BW**				
30 d (kg)	10.1	10.2	-	-	-	-	-
120 d (kg)	31.2	22.5	210 d (kg)	43.8	33.9	36.3	26.6
ADG (30-120 d) (g/d)	235	136	ADG (121-210 d) (g/d)	138	31	153	57
FCR (%)	4.13	4.69	FCR (%)	11.1	38.7	8.57	15.26

HQD: high quality diet; LQD: low quality diet; H-H: HQD pre and post-weaning; H-L: HQD pre-weaning and LQD post-weaning; L-H: LQD pre-weaning and HQD post-weaning and L-L: LQD pre and post-weaning (control).
DM: dry matter; ME: metabolite energy; CP: crude protein; BW: body weight; ADG: average daily gain and FCR: feed conversion ratio.

Table 3 Effect of pre-post-weaning diet quality on serum insulin and leptin concentrations of ewe lambs (30-210 d of age)

Item	Pre-weaning treatments		Post-weaning treatments			
	HQD	LQD	HQD		LQD	
-	-	-	H-H	H-L	L-H	L-L
n	20	20	10	10	10	10
Insulin (μLU/mL)	4.45	2.09	4.48	2.32	3.59	1.35
Leptin (ng/mL)	2.84	2.20	3.03	2.06	3.66	1.98

HQD: high quality diet; LQD: low quality diet; H-H: HQD pre and post-weaning; H-L: HQD pre-weaning and LQD post-weaning; L-H: LQD pre-weaning and HQD post-weaning and L-L: LQD pre and post-weaning (control).

Most Kurdish ewe lambs achieved puberty by 210-240 d of age when their average live weight was approximately 35 kg, or approximately 65% of their estimated mature live weight (Ehtesham and Vakili, 2015). The average puberty age of H-H and L-H groups were lower than H-L and L-L groups, respectively (P<0.05, Table 2). Based on the results of current study ewe lambs with higher growth rate were more likely to achieve puberty. And also these lambs were heavier at weaning time and grew faster during the post-weaning period. The ewe lambs of H-L group were heavier than ewe lambs of L-L group at weaning time and post-weaning period.

These results are consistent with previous reports that faster growth results in more ewes achieving puberty at a younger age in female sheep (Rosales Nieto *et al.* 2013). The most of ewe lambs of L-L group did not show puberty at 210 d of age and therefore they were removed from first reproduction table. The average puberty age of H-H sequence was lower than other treatments, with no significant interaction of per-post weaning (P<0.05).

Hormone

The mean of serum insulin and leptin concentrations of ewe lambs at pre- post-weaning are shown in Table 3. Serum insulin concentrations was higher for lambs fed HQD compared with lambs fed LQD (4.45 *vs.* 2.09 µIU/mL, respectively, Table 3).

Animals in H-H treatments had higher serum insulin concentration at 210 d of age compared with other treatments. While leptin concentration of ewe lambs of L-H group was higher than in other treatments at 210 d of age. These results indicated that maybe increasing weight gain at post-weaning contributed with higher fat fraction and also ultrasonography evidence from fat and muscle diameter of between 12-13 ribs area support these results (the results was not reported).

Little is known about the importance of leptin in the early postnatal period, despite its potential role in important processes such as mammary gland and appetite regulation and variety of other effects in the body (Daniel *et al.* 2013).

Leptin is synthesized and secreted primarily and particularly in adipose tissue, in addition to multiple other sites of production including the mammary gland and leptin regulated by multiple hormones including somatotropin, insulin and Insulin-like growth factor 1 (IGF-I) (Smith and Sheffield, 2002). Leptin concentration was positively associated with higher values for growth and fat accumulation and therefore with an improvement in reproductive performance (Rosales Nieto *et al.* 2013). The current results support this concept because leptin concentration was positively correlated with body fat; however endocrine links to the reproductive control centers have not been clearly identified. The hormones insulin and leptin have primary roles on control of reproduction in sheep.

In times of decreased feeding, these hormones interact at the hypothalamus to reduce reproduction and enhance feeding (Besson *et al.* 2016). Thus, nutrient reprioritization occurs in part at the expense of reproductive function as a survival mechanism. For example, reduced insulin occurs to spare glucose for central nervous system function, reduced leptin to allow stimulation of nor peptide Y to in turn increase appetite as well as changes in anabolic hormones, and ultimately, reduce K_p and Gonadotropin-releasing hormone (GnRH) until feed is more readily available (Daniel *et al.* 2013). Rosales Nieto *et al.* (2013) reported that leptin levels positively correlated with earlier puberty onset in ewe lambs. And also these authors reported that leptin concentration was not related to age at first estrus, but puberty and BW at first estrus was positively correlated with leptin concentration (Rosales Nieto *et al.* 2013).

Progesterone can be used to monitor the pregnancy status and timing of puberty (Olfati *et al.* 2014). Within the post-weaning, serum progesterone concentrations were greater for ewe lambs fed at H-H group than for those fed the L-H, H-L and L-L treatments respectively (P<0.05, Figure 1). In conclusion, it was concluded that pre-pubertal plan play the important role in secretion of progesterone, which leads to early sexual puberty. The present findings demonstrate that in the female lamb, may be LQD impairs the systems governing luteinizing hormone that controls follicle growth and cycle hormone (progesterone secretion) and delays puberty.

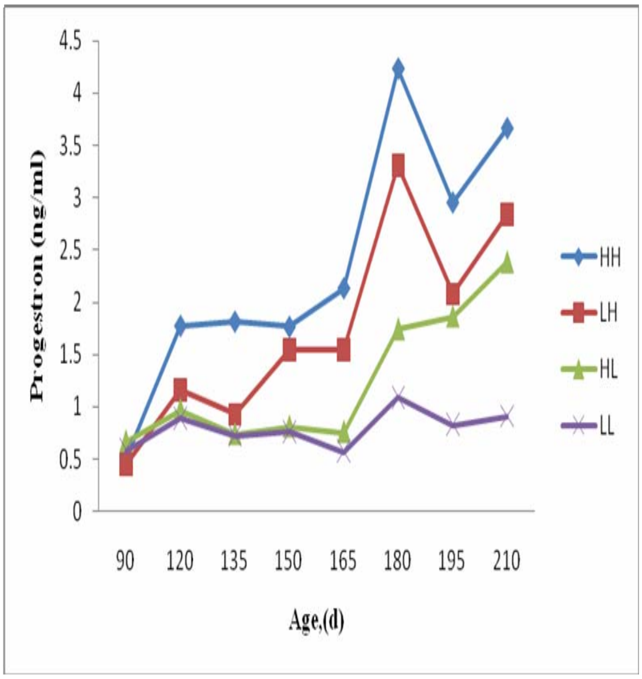

Figure 1 Serum progesterone concentrations from 90 to 210 d of age for ewe lambs fed the H-H (♦), H-L (▲), L-H (■) or L-L (×, control)
HQD: high quality diet; LQD: low quality diet; H-H: HQD pre and post-weaning; H-L: HQD pre-weaning and LQD post-weaning; L-H: LQD fed pre-weaning and HQD fed post-weaning and L-L: LQD fed post-weaning.

Reproduction performance and milk yield

Puberty in female sheep is defined by the first ovulation because that is when reproduction becomes possible (7-9 months). In the present study results showed that the lambs were pregnant received successful pregnancy about 90 days after achieving puberty. Based on our results, this deduction, and together with the observed rates of puberty achievement (100% in H-H and L-H, 70% H-L and 40% in L-L) and pregnancy (100% H-H, 70% L-H, 60% H-L and 20% in L-L). Corner *et al.* (2013) revealed that during pregnancy the ewe lamb is not only supporting a developing fetus but is also likely to be still growing herself. Wallace *et al.* (2001) have previously shown that ewe lambs have the potential to partition available resources towards themselves rather than the growing fetus. This hypothesis is supported by the weak results of ewe lambs in H-L and L-L groups that had lower growth rate rather than other groups. The L-L group was removed from the reproduction performance and milk yield-composition tables, because eight lambs were not pregnant. The pregnant ewe lambs of H-H, H-L, L-H and L-L treatment were 10, 5, 7 and 2 respectively (Table 4).

Table 4 Effect of post-weaning plan of nutrition on progeny weight on lamb's birth weight and milk quality-quantity

Item	Post-weaning treatments			
	H-H	H-L	L-H	L-L
n	10	5	7	0
Lamb birth weight (kg)	2.7	2.8	3.6	-
Milk yield (g/d)	300	300	374	-
Milk composition				
Fat (%)	4.82	4.44	4.65	-
Protein (%)	4.49	4.49	4.57	-
Lactose (%)	4.24	4.28	4.40	-
FCM 6.5% (g/d)	252	233	304	-
ECM (kg/d)	385	357	465	-

HQD: high quality diet; LQD: low quality diet; H-H: HQD pre and post-weaning; H-L: HQD pre-weaning and LQD post-weaning; L-H: LQD pre-weaning and HQD post-weaning and L-L: LQD pre and post-weaning (control).
Fat corrected milk with 6.5% fat (FCM 6.5%)= (kg milk yield×(0.37+(0.097×% fat)).
Energy corrected milk (ECM)= (0.327×kg milk yield) + (12.95×kg fat) + (7.2×kg protein).

Results of our study show that increased energy and protein intake by ewe lambs by consuming milk, can increase the rate of BW gain. Based on DMI for the HQD and NRC (2007) recommendations, these lambs (H-H and L-H groups) were expected to gain 200 g/d during post-weaning. However lambs fed the HQD did not achieve their targeted rate of gain during this period.

Ewe lambs milk yield was affected by treatments (P<0.05, Table 4), but ewe lambs milk compositions (fat, protein and lactose) was not affected by diet quality (P>0.05). Ewe lambs of L-H treatment produced more milk than in H-H and H-L treatments. However, higher BW and better body condition help to lambs for easy transit of negative energy balance in first-lactation period. The indirect evidence from lactation studies in sheep (Umberger, 1980) suggest that continuous rapid growth before and after the main allometric growth phase may depress mammary development when compared with feeding regimes involving at least one phase of restricted feed intake. The primary hypothesis to explain reduced milk yield when replacement ewe lamb growth is accelerated is that the development of mammary secretary tissue is reduced because of the high energy demand to accelerate growth (Hoffman and Funk, 1992).

CONCLUSION

The present study confirmed that a HQD diet improved the BW and ADG at weaning and breeding time. Based on the results of this research weaning weight, previous nutrition plan and current nutrition level are factors that determine puberty age, milk yield and milk composition. To conclude, it was concluded that pre-pubertal plan play the important role in secretion of progesterone, insulin and leptin, which can leads to early sexual puberty. And also these strategic plans should be improve economic traits the start of lamb's puberty in sheep husbandry.

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