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Improvement of Fertility Performance of Farahani Ewes Raised on Supplementary Feeding

Research Article

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ABSTRACT

This study deals with effects of supplementary feeding on fertility performance of Farahani ewes. The study was conducted using three local flocks in Arak city, Iran. Half ewes in each flock (50 ewes from each flock) were used as control group and fed according to traditional method without supplementary feed. The other half per flock was fed on supplementary feed throughout the experiment that included three stages of breeding, late Pregnancy, and lactation. Weight and body condition score was measured in all ewes before supplementary feeding at breeding and at the end of the experiment. Average weight and body condition score at the measuring period were 39.4 ± 1.3 kg and 2.09 ± 0.26 for the control group; and 42.34 ± 1.26 kg and 2.56 ± 0.34 for the experimental group, respectively. The difference between two groups was significant ($P<0.01$). Implementation of supplementary feeding had significant effect on the birth and weaning weights of lambs. Average birth weight of lambs in control and experimental groups was 3.38 ± 0.14 and 4.09 ± 0.14 kg, respectively. Lambs weights at one, two and three months of ages for the control group were 9.16 ± 1.4, 12.99 ± 2.03 and 22.65 ± 2.3 kg and for the experimental group were 11.23 ± 1.4, 16.55 ± 2.03 and 27.21 ± 2.3 kg, respectively (significant difference ($P<0.01$)). Pregnancy rates for the control and experimental group were 85.29% and 94.4%, respectively ($P<0.01$) and lamb mortality rates were 10.34% and 3.48%, respectively ($P<0.01$). These findings showed that supplementary feeding improved fertility and lambing performance. Moreover, the birth weight and weaning weight of lambs showed significant improvement as well. The overall, increasing of lambing ewes (of about 14 percent) and increase in lamb birth and weaning weights were the obtained economic benefit from this research.

KEY WORDS Farahani ewes, fertility, lamb's weight, supplementary feeding.

INTRODUCTION

Modern sheep raising puts a great emphasize on meat production. Therefore, higher performance demands increase in fertility rate. Sheep production process includes mating, pregnancy, lactation and maintenance stages (Molina *et al.* 1994; Al-Haboby *et al.* 1999). In ewes, there are 4 months gap between the end of lactation and the following mating. With a better feeding pregame, the ewe earns better physical condition, which in turn facilitates the release of gonadotropin hormones that are necessary for superovulation and higher chance of lambing and twinning. The extra feeding also stimulates estrus to occur faster and more intensely after lactation (Brand *et al.* 1997).

Hence, it is important to provide a diet with higher protein and energy 3-4 weeks before mating or artificial insemination. Since the majority of prenatal mortality will happens in the first 25 days after conception due to poor feeding condition. Therefore, supplementary feeding 3-4 weeks after mating can increase the chance of zygote plac-

ement in the uterus wall (Brand *et al*. 1997; El-Hag *et al*. 1998; Attia *et al*. 2001). There are several theories about the flushing effect on estrus in ewes such as early initiation of mating season and prolonged estrous cycle (Molina *et al*. 1994). Research has shown the importance of flushing on lambing and flock infertility reduction in young ewes and ewes with low body condition score (Esmaeilizadeh *et al*. 2003). In a research on Awasi sheep, in Jordan, results showed that hormone interventions (PMSG, 500 IU) and supplementary feeding enhance the rate and efficiency of reproduction (Nasr *et al*. 2002). Biuret as nitrogen food supplement for flushing grazing ewes increased lambing up to 26.3% (Torell *et al*. 1972). Supply of adequate nutrients during the last 6 weeks of pregnancy period affects lamb weight and ewe health. Poor nutrition during gestation may result in preterm birth and higher mortality rate, low weight and weak lambs born. Moreover, it may cause reduction of milk production due to under-development of mammary glands (Al-Sabbagh *et al*. 1995; Muñoz *et al*. 2009).

Effect of feeding 150g peanut meal for 45 days before mating and the last 45 days of gestation under field condition has been investigated in north Kurdofan at Sudan. The effect of flushing resulted in an increased fertility rate and fewer fetal disorders. In addition, supplementary feeding during late gestation period increased lamb birth weight and minimized gestation stresses (El-Hag *et al*. 1998). According to the economic importance of sheep production- especially meat production for rural families, any improvement in meat production in sheep has a great effect on the income and the protein supply of this community. Therefore, this study was conducted to evaluate the effect of supplementary feeding in critical production stages of breeding, pregnancy and lactation on reproductive performance and lambing of Farahani ewes in Arak city, Iran.

MATERIALS AND METHODS

The study was conducted on three flocks of ewes (150 ewes in each flock) from Farahani breed in Arak, Iran. Before allocation to dietary treatments, ewes were weighted and their body condition was scored (using 1-5 scale). Ewes were ranked into six pools (1-5) and randomized into control and experimental group using complete randomization block design, having equal number of ewes per pool in each group.

The mean and standard error of body weight and body condition score of the ewes before flushing were 37.73 ± 1.35 kg and 2.17 ± 0.9 for the control group and 38.85 ± 0.83 kg and 2.21 ± 0.05 for the experimental group. Body condition scoring (BCS) (BCS=1 for emaciated ewes to BCS=5 for obese ewes at 0.5 intervals) described by Russel *et al*. (1969) was used in this study.

The BCS of the ewes in this system was based on palpation of the tips of both the spinous and the transverse processes of the vertebrae and the fullness of muscle and fat cover over and around the vertebrae in the loin region. The scores were allocated as follows: BCS 1, the spinous processes were sharp and prominent, the loin eye muscle shallow, with no fat cover; BCS 2, sharp and prominent spinous processes, the loin eye muscle having little fat cover, but full; BCS 3, the spinous processes are smooth and rounded and one can feel individual processes only with pressure, the loin eye muscle was full with some fat cover; BCS 4, the spinous processes can be detected only with pressure as a hard line, the transverse processes cannot be felt and loin eye muscle was full with a thick fat cover; and with a BCS 5, it was impossible to detect the spinous processes, and the loin eye muscle was very full with a very thick fat cover (Russel *et al*. 1969). The ewes grazed in Ebrahim Abad region of Arak countryside from spring to mid-autumn without supplementary feed. Supplementary feeding for the first phase of the study for the experimental group was introduced three weeks before until two weeks after mating. Concentrate intake started by small amounts (approximately 100 g per day) and increased to the normal amount within a week (300 g per day) and continued until two weeks after mating. The rams were allowed to the flocks three week after initiation of the supplementary feeding program. The concentrate contained barley, wheat bran, cotton seed meal, corn, bagasse, dried pulp sugar beet, salt and mineral and vitamin supplement. Ewes in the control group were kept on pasture without supplementary feed. After flushing, all ewes were weighed and body condition scored. The second supplementary feeding phase started approximately 45 days before lambing. During this phase, ewes in the control group were fed with wheat straw, dried alfalfa, and 100-150 g barley according to usual farming practices in the region. Ewes in experimental group received an extra 400 g supplementary feed during 14^{th}-16^{th} week of gestation, 430g during 16^{th}-18^{th}, and 450 g during 18^{th}-20^{th} week of gestation. In the third stage of the study, ewes in the experimental group received supplementary feeding after parturition and during lactation. The ewes in the control group received the routine diet including alfalfa (400-500 g) and an amount of barely seed in early period of lactation (100-150 g). Ewes in the experimental groups, in addition to the control diet, were fed 500 g of concentrate daily. Lactating ewes received the supplementary feeding for 3 months. Exact date of lambing birth weight and sex of lambs were recorded. Thereafter, lambs' weight was recorded at the end of each month during the experimental period. Fertility rate, mortality rate, and weight at birth and weaning (three months) were recorded for control and experimental groups.

Data were analyzed in SAS (2011) with procedures of analysis of variance using PROC MIXED, and the records were compared using Duncan's multi domain test.

RESULTS AND DISCUSSION

As represented in Table 1, induction of flushing caused significant increase in weight and body condition score of ewes at the end of first stage of supplementary feeding. The adjusted average weight of ewes during mating period in the experimental and control groups were 42.34 ± 1.26 kg and 39.40 ± 1.3 kg, respectively (P<0.01); Regarding the body condition score, the figures were 2.56 ± 0.34 and 2.09 ± 0.26 respectively (P<0.01).

Table 1 Effect of flushing on body weight and body condition score (BSC) of ewes at the end of supplementary feeding

Treatment	Average body weight (kg)	Average BSC
Flushing group	42.34[a]	2.56[a]
Control group	39.4[b]	2.09[b]
SE	1.13	0.26

The means within the same column with at least one common letter, do not have significant difference (P>0.01).
BSC: Body condition scoring.
SE: standard error.

Considering poor quality pasture in the mentioned region in late summer and close to mating, ewes were suffering from malnutrition and had undesirable weight and body condition score. Other studies confirmed the result of this study for the effect of body condition score before mating on fertility rate. Improvement of body condition score during this stage results in reduced open days, increased ovulation rate and low incidence of fetal loss (Al-Sabbagh *et al.* 1995). In the study Vatankhah *et al.* (2012), the significant effect of BCS on ewe body weight, showed that improving the BCS could increase the ewe body weight and vice versa. The means for reproductive traits of different levels of BCS showed that, a higher BCS at mating, led to a higher conception rate, number of lambs born and weaned per ewe exposed and a lower number of estrous cycles to conception per mating season. However, ewes with a BCS of 4 at mating, tended to exhibit a higher incidence to be non-pregnant and a lower twinning rate. The reason for the reduced conception rate in low BCS ewes may be a reduced GnRH production in undernourished ewes. The body weight of the ewe at mating has been shown to influence the subsequent litter size and the ewe's productivity (Vatankhah and Salehi, 2010). The body weight of the ewe generally has two components, the basic skeletal size of the sheep and the degree of fatness (body condition) of the animal. Due to the variation in skeletal size between ewes, body weight alone cannot indicate the degree of fatness. Body condition score is thus an estimation of muscle and fat development in animal.

Although, there are many reports suggesting a positive correlation between BCS at mating and reproductive performance (Abdel-Mageed, 2009; Sejian *et al.* 2010; Yilmaz *et al.* 2011), but the responses of female sheep to supplementary feeding prior to mating is variable according to the factors such as the prevailing level of feeding and body condition score.

The findings of Lassoued *et al.* (2009) showed that ewes of the "Queue Fine de l'Ouest" breed with an optimum live weight responded better to flushing when feed allowances were adjusted to 100 rather than 160 of their metabolizable energy for maintenance.

Research on Kurdi ewes confirmed significant effects of weight and body condition score of the ewes on fertility and lambing rate. In this research, increase of body condition score from 2 to 3.5 resulted in a decrease of infertile ewes and increase of lambing rates in autumn (Esmaeilizadeh *et al.* 2003). Provision of supplementary feeding during critical stages (mating, third semester of pregnancy and lactation) had a significant effect on birth weight and weight gain in the first three months of age (P<0.01) (Table 2). In other words, provision of supplementary feeding to ewes improved birth weight and weaning weight (P<0.01). Table 2 also addresses the effect of ewe body weight at mating and gestation on lambs weight. Ewes were classified in three weight groups. Ewes in the heaviest weight group delivered heaviest lambs followed by the second and lightest weight group. Similar applies for the weight growth until weaning. A significant difference was observed for lambs of the heaviest group, but no differences between weights of lambs of second and lightest weight group.

Yilmaz *et al.* (2011) found significant effects of BCS on pregnancy rate, lambing rate and fecundity. The best BCS for the highest pregnancy, lambing rate, and fecundity was between 2.01 and 3.00, while the lowest rate for these traits was ≤ 1.50.

In this study, the highest rates of the pregnancy rate, lambing rate and fecundity and gestation productivity were 75.9%, 70.9%, 1.11 and 3.34 kg, respectively. BCS is also a way of evaluating the nutritional status of a flock and acts as a potential indicator for sheep owners to increase the production efficiency in their flock (Sejian *et al.* 2010).

Based on the results of Table 2, lambs with the highest weight at birth and first three months after birth was belong to the ewes with body condition score between 2.5 and 3. It was widely demonstrated in ewes that the higher body condition score led to the higher number of lambs born per ewe.

In addition to this simple effect at mating, body condition also influences the response of the ewe to the level of feeding. Ovulation rate increases broadly in line with ewe condition.

Table 2 Effect of flushing, body weight and body condition score (BCS) of Farahani ewes on the lambs weight at different age

	Numbers of lambs	Birth weight	Weight at age 1 month	Weight at age 2 month	Weight at age 3 month
Flushing group	137	4.09[a]	11.23[a]	16.55[a]	27.21[a]
Control group	115	3.38[b]	9.16[b]	12.99[b]	22.65[b]
SE	-	0.14	1.4	2.03	2.3
Ewe mating weight					
36-41 kg	81	3.76[b]	10.5[b]	15.30[b]	25.18[b]
42-47 kg	87	3.95[ab]	10.43[b]	15.34[b]	26.11[b]
48-56 kg	84	4.13[a]	11.19[a]	16.58[a]	27.69[a]
SE	-	0.16	1.35	1.56	1.87
Ewe gestation weight					
38-42 kg	81	3.80[b]	10.50[b]	15.00[b]	25.26[b]
43-50 kg	85	3.99[ab]	10.60[b]	15.50[b]	26.15[b]
50-58 kg	86	4.16[a]	11.21[a]	16.67[a]	27.70[a]
SE	-	0.17	1.37	1.54	1.84
Ewe BCS at mating					
2	57	3.5[abc]	9.83[b]	13.6[ab]	23.52[b]
2.5	59	4[a]	10.94[a]	16.12[a]	26.67[a]
3	71	4.09[a]	10.92[a]	16.3[a]	27.35[a]
3.5	65	3.9[ab]	9.5[b]	13[b]	23[b]
SE	-	0.19	1.38	2.2	2.33

The means within the same column with at least one common letter, do not have significant difference (P>0.01).
SE: standard error.

However, the quality of nutrition at mating only has a strong positive or negative effect upon ovulation rate in ewes over the mid range of condition scores. Therefore, management prior to mating should be such as to avoid having ewes in extremes of condition as they will not respond to better grazing or supplementary feeding (Maurya *et al*. 2009; Muñoz *et al*. 2009). It was observed that well-fed dams during gestation led to heavier and stronger lambs (Chowdhury *et al*. 2002). A significant variation in the birth weights of kids during different periods of fodder availability was also reported (Wenzhong *et al*. 2005). Yaqoob *et al*. (2009) observed a significant variation in both pre-weaning and post weaning weights during different periods of fodder availability that can be explained by variations in amount of annual rainfall, which in turn influenced pasture production and availability of feed. Kids prior to weaning depended mainly on dam's milk as food, the production of which was directly related to the availability of feeds to does. Variation in supply and composition of feeds and fodder during various periods of a year affects weight of kids at different life stages. Several reports indicated that season and year of birth and type of birth influenced body weight and growth rate in goats.

Rahmani *et al*. (2000) confirmed the positive relation between ewe weight and age with lamb weight. Better nutrition of ewe during critical stages increases weight of the lambs. Provision of adequate nutrients in the last 6 weeks of gestation is essential for normal growth of foetus, development of mammary glands, higher birth weight of lambs and health of ewe (Esmaeilizadeh *et al*. 2003).

One explanation for this is that lamb growth rate and capability of milk production in ewes is highly dependent on nutrition in the late gestation period (El-Hag *et al*. 1998).

Chinese Merinos ewe with weight less than 42 kg at mating showed relatively lower estrus and conception rates, and lambing percentage comparing to ewes heavier than 57 kg (Wensheng and Yajun, 2001) which is parallel with our results (Table 3).

Deficiency in energy and protein during mating season causes low pregnancy rate and ewes lambing. Improvements in subsequent lamb percentages (5 to 15%) are generally noted as a result of flushing ewes during mating. These are due to two main effects, firstly an increase in the number of eggs shed and secondly, an increased chance of a successful early pregnancy of which many will be multiples. Flushing also increased the ovulation rate of the ewes and the litter size (Brand *et al*. 1997).

Table 3 Effect of flushing on mean pregnancy rate of Farahani ewes

	Mean pregnancy rate (%)	t statistics
Flushing group	94.44	1.95**
Control group	85.29	-

** (P<0.01).

The low BCS after partum was caused a change in the reproduction performance, such as failure in ovulation, extended period of estrous post partum and lambing interval. Body condition score of ewes influence on the gonadotropin secretion, growth and development of the follicle and corpus luteum, and ovarian activity (Widayati *et al*. 2011).

Therefore, provision of supplementary feeding is the best option to achieve higher reproductive performance. One way of providing nutrients needed is feeding blocks of by-pass product from agricultural and food industries around mating season. The positive effect of providing the ruminant animal with non-degradable protein in improving ovulation and fertility rate among sheep and goat has been reported (Al-Haboby *et al*. 1999).

The results of this study also showed a positive and significant effect for supplementary feeding on mortality rate of lambs (Table 4).

Table 4 Effect of flushing on mortality rate in lambs from birth to weaning

Group	Mean mortality rate of lambs (%)	t statistics
Flushing group	3.48	-1.67**
Control	10.34	-

** (P<0.01).

The factors contributing to the early postnatal lamb and kid mortality are birth type (single, twins or triplets), sex, birth weight and season, age and nutritional status of dam, management, and maternal and neonatal behavior (Yaqoob *et al*. 2009).

CONCLUSION

The results of the current study clearly showed the positive effect of supplementary feeding during critical stages of life span on body weight and BCS of Farahani ewes. Better body weight and BCS led to significant improvement both in fertility rate and lambing percentage of ewes and higher birth and weaning weight of lambs. Since the province pasture have the inappropriate quantity and quality in the late summer, that is close to mating season, so the use of supplementary feeding three weeks before mating until two weeks after that, increases the ewes body weight gain and body condition score. Supplementary feeding can be useful in compensating for deficiencies in grazing or by further enhancing the "quality" of nutrition.

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