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Effect of Flushing on Production and Reproductive Performances of Arsi Bale Highland Ewe

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Keywords

Barley grain,
Hay,
Flushing,
Production,
Reproductive

Abstract

The objective of this study was to evaluate the effect of flushing on production and reproductive performances of Arsi Bale highland ewe. 24 Arsi ewes were used for trail. The treatments are T_1 (hay+350 g of barley grain), T_2 (hay+287.5 g of barley grain), T_3 (hay+225 g of barley grain) and T_4 (only natural pasture hay). All ewes, except in the control diet were supplemented with barley grain for 3 weeks prior and 4 weeks after breeding. Reproductive performances of ewes like conception rate, lamping rate, litter size, abortion rate, and dam weight before and after flushing, lamb birth and weaning weight and lambs mortality were assesed. All collected and analyzed using SAS and R software and Tukey test was used to separate mean differences at 5% significance level. Conception rate of ewe was 83% for T_1 and 100% for T_2, T_3 and T_4 and revealed as there is no significant differences ($P>0.05$), while lamping rate was 120% in T_1, 100% in T_2 and 83.3 and 66.7 for T_3 and T_4, respectively and there is significant ($P<0.05$) difference between treatment groups. The birth weight of lambs was 2.3 kg, 2.1 kg, 2.03 kg and 1.8 kg for T_1, T_2, T_3 and T_4, respectively and the average weaning weight of lambs was 11.3 kg, 10.3 kg, 9.9 kg and 9.0 kg for T_1, T_2, T_3 and T_4, respectively.

Introduction

Small ruminant significantly contribute to agrarian economy and plays a vital role in livelihood, security of marginal and landless farmers especially in arid, semiarid and hilly regions of the country by providing a household nutrition and contribute to the family income through meat, wool/fiber, skin, milk and manure with little or no feed supplementation (Shad *et al*., 2011). The primary determinant factor of fertility and fecundity in ewe depends on ovulation rate. Female sheep gains weight and fat reserves in the first 3-4 weeks prior to mating and are more likely

to conceive and have twins or triplets that have got flushing than those in poorer condition (Shad *et al*., 2011).

Nearly 40 years ago it was postulated that the ovaries of ewes fed on a high plane of nutrition would contain more follicles, than would the ovaries of ewes fed a low plane of nutrition and that, a given quantity of gonadotrophin would cause greater ovarian stimulation. Ewes fed a sub-maintenance diet, administration of PMSG (Pregnant Mare Serum Gonadotropin.) increased the number of follicles present, suggesting that nutritional effects on ovarian activity in ewes were related to the concentration of gonadotrophin presence in the blood reaching the ovary (Downing, 1991).

Nutrition is one of the most significant influences on the ovulation rate of sheep. Short periods of improved nutrition before and during mating increase the proportion of ewes bearing twins, this practice has been termed `flushing' and described thus "The practice of 'flushing' consists of giving ewes which are in fairly poor condition an improved diet for a few weeks before mating so that they are in rapidly rising condition when they meet the ram" (Downing, 1991).

The period from weaning to breeding of ewes is critical if a high twinning rate is desired. Ewes should not be allowed to become excessively fat but should make daily gains from weaning to breeding. If pasture production is inadequate, ewes may be confined and fed high-quality hay and a small amount of grain if necessary.

Beginning 6–8 weeks before lambing, the plane of nutrition should be increased gradually and continued without interruption until after lambing. The amount offered depends on the condition or fat covering of the ewes and quality of the forage. If ewes are in fair to good condition, 0.5–0.75 lb (225–350 g) daily grain is usually sufficient (David.G. 2020).
Barley is one of the major cereal crops that are largely produced in the central and south east mid and high altitude areas of Ethiopia. Barley is used primarily as an energy and protein sources in sheep diets and it does not require processing when used in sheep diets. Expressed on a dry matter basis, barley has 7.5-18% protein and a total digestible nutrient (TDN) value of 80-84%. Arsi zone is characterized by a cereal dominated farming system in which bread wheat and barley are the major crops (Bedada *et al.*, 2014). So, the aim of this study is to evaluate the supplemental effect of barely grain based flushing on reproductive and productive performances of Arsi Bale highland ewe.

Materials and Methods

Description of the study area

The study was conduct in Bishoftu town Oromia Regional state (Fig. 1). The town is at 45 km South East of Addis Ababa. The area is located at 9°N latitude and 40°E longitude and altitude of 1850 meters above sea level with annual rain fall of 866 mm of which 84% is in the long rainy season from June to September. The annual average temperature ranges from 12.3 to 27.7°C with an overall average of 18.7°C. The soil and climate are similar to those in many highland areas in Ethiopia. Cattle, small ruminant, poultry and equines are the major livestock species kept in the area and the smallholder dairy production with fast growing.

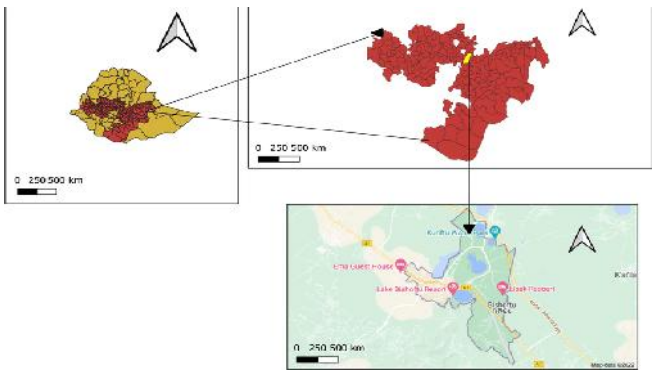

Fig. 1: Map of Bishoftu town

Characteristic and Distribution of Arsi Bale Sheep Breed

Arsi Bale sheep breed are among the potential breeds of Ethiopia reared in the mixed crop and

livestock production system of Ethiopia. They are long fat-tailed and hairy. Arsi Bale breed is distributed in wet, cool and warmer highlands (2000–3300m); sub moist lowlands and mainly found in Arsi, Bale, East Shoa, West Hararghezones and some districts in Borana zones, Hadya, Gurage, Kembata and Sidama zones (Berhanu and Oli, 2020).

Experimental Feed Storage

The basal diet (natural pasture hay) sufficient for all ewes up to the end of feeding was purchased from Arsi zone and taken and stored in appropriate place at experimental site (Fig. 2). The barley grain (experimental diet) was also purchased from the nearby market and stored until flushing was started.

Fig. 2: Natural pasture hay used as basal diet

Management of Experimental Animals

Twenty four (24) Arsi Bale highland non pregnant ewes (after checking by traditional system) at their 7 to 8 month and 2 mature rams (for mating) were purchased from the Sagure market. The age of the ewe was determined by dentition. Only those animals, which did not gave birth before were selected to remove the unwanted effect of reproductive disorder in the study. All the sheep were quarantined for 15 days at the experimental site in until they are adopted to new environment. The animals were vaccinated against ovine pasteurellosis, sheep pox and anthrax, with 1 ml of ovine pasteurellosis vaccine subcutaneously for one Sheep, 1 ml of diluted vaccine injected subcutaneously on the inner face of the thigh for one sheep, *1 ml of diluted vaccine injected subcutaneously*, respectively. In addition all sheep were de-wormed against external parasites like tick and mange. Soon after flushing, the sheep were weighted (Fig.3) and divided randomly into 4 groups of T_1, T_2, T_3 and T_4 and 6 ewes in each treatment.

Fig: 3: Weighing of ewes before (left) and after (right) flushing

Flushing was done by T_1: natural pasture hay plus 350 g of barley grain/head/day (maximum), T_2: natural pasture hay plus 287.5 g of barley grain/head/day, T_3: natural pasture hay plus 225 g of barley grain/head/day and T_4 as control group without flushing ration, based on David (2020), which say if ewes are in fair to good condition, 0.5–0.75 lb (225–350 g) daily grain is usually sufficient for flushing. And there was 6 ewe under each treatment groups, totally 24 ewe was included under study.

Natural pasture hay as basal diet and barley grain as experimental diet was used for experiment. In addition, minerals (one spoon calcium and one spoon of zinc per sheep was provided by mixing it with feed), salt and clean tap water was provided for all groups equally. All experimental ewes were identified by number written on their skin and on the wall in front of each animal (fig.4). Ewe under experiment was flushed for three weeks before breeding and four weeks after breeding.

Fig 4. Ewe identified by number given (left) Ewe eating barley during flushing (right)

Determining production and reproduction performance of sheep

After three weeks of flushing, on 21th day, the ewes were allowed for mating. Various reproductive parameters such as conception rate (ewe conceived/Ewe mated) and lambing rate (number of lambs born alive/ewe conceived), abortion rate (ewe abort/ewe conceived) and litter size (single, twin or triplet) and production performance like BW of dam before and after flushing, birth weight and weaning weight of lambs were also studied. Lams were weighed soon after birth (Fig. 5 left) to see their birth weight and weaning weight was taken at their three months of age (Fig. 5 right).

Fig 5. Weighing of lambs at birth (left) Weighing of lambs at weaning age (right)

The reproductive performances of ewe were calculated as follow:

1. Conception rate =Number of ewe conceived/Number of ewe mated *100
2. Lambing rate =Number of lamb born alive/number of ewe conceived *100
3. Abortion rate=Number of ewe aborted/number of ewe conceived *100
4. Pre weaning lamb mortality rate=Number of lambs dying before weaning /total lambs born alive *100 (Menzies, 2006)

Data was analyzed using the General Linear Models procedure of SAS and software. Turkey's honest significant test was employed for separation of treatment means.

The statistical model for the production and reproductive performances was

$Y_{ijk} = \mu + t_i + e_{ij,}$
Where, Y_{ijk} is the response variable (reproductive performance of ewe)
μ= is the overall mean,
t_i= is the treatment effect,
e_{ij} = error term

Result

Effect of Flushing on Reproductive and Production Performances of Ewes

Effect of Flushing on Conception rate:

Conception rate was calculated as number of ewe conceived per number of ewe mated *100. The conception rate of ewe in the current study was 83.3% for T_1 and 100% for T_2, T_3 and T_4 (Table1). Out of twenty four (24) ewes under four treatment groups twenty three (23) of them was conceived (Table1). So, the total conception rate was 95.8%. And there is no significant differences (P>0.05) among the treatments.

Effect of Flushing on Lambing rate

Results on lambing rate is presented in (Table 1) below. As observed from the results, the lambing rates of ewes under treatment groups were 120%, 100%, 83.3% and 67.7% for T_1, T_2, T_3 and T_4, respectively and there is significant (P<0.05) differences between treatment groups. Lambing rate was high in T_1 and T_2. All lambing ewes under T_1 and T_2 gave twin birth, but in opposite twin birth could not seen under T_3 and T_4 fed ewes. The number of ewes gave birth were three (3) under T_1 and under T_2 and five (5) and (4) under T_3 and T_4, respectively, but the number of lambs born alive was (6) under the first two treatment groups and (5 lambs) and (4 lambs) under T_3 and T_4 respectively. All ewes under first two treatment group was give twin birth, but under T_3 and T_4 there is no twin birth at all. This is a clear indication as flushing increase ovulation rate of ewes.

Table 1: Effect of flushing on conception, lambing and abortion rates

Treatments	Parameters				
	Number of Ewes mated	**Conception rate, N (%)**	**Number of Ewes gave birth, N (%)**	**Abortion rate, N (%)**	**Lambing rates, N (%)**
T_1	6	5 (83.3)	3 (50)	2 (40)	6 (120)
T_2	6	6 (100)	3 (50)	3 (50)	6 (100)
T_3	6	6 (100)	5 (83.3)	1 (16.7)	5 (83.3)
T_4	6	6 (100)	4 (66.7)	2 (33.3)	4 (66.7)
Total	24	23 (95.8)	15 (62.5)	8 (33.3)	21
Sig.		0.413	0.55	0.67	0.076
CV		8	27	46	6

N: number; Sig= significance level; T_1= natural pasture hay+350 g barley grain; T_2= natural pasture hay+287.5 g barley grain; T_3= natural pasture hay+225 g barley grain and T_4= natural pasture hay only, CV= Coefficient of Variation

Effect of Flushing on Abortion rate

Abortion rate were 40%, 50%, 16.6% and 33.3% in T_1, T_2, T_3 and T_4, respectively and a significant ($P>0.05$) difference was not seen among the treatments. Abortion was slightly higher in T_1 and T_2, and occurred at the 3rd to 4th months of pregnancy. All ewes under the treatments were served at ten months of their age and it was their first parity, so, their uterus may be unable to accommodate the fetus and increase risk of abortion.

Effects of Nutritional Flushing on Litter Size

Measurement of the litter size of Arsi Bale ewes is presented in (Fig. 6). There is a significant ($P<0.05$) differences on litter size among treatment groups. The ewes under T_1 and T_2 gave twin birth; however, ewes under T_3 and T_4 (control group) did not gave a twin births (Fig.6). The twin birth in the T_1 and T_2 was an indication of increased ovulation rate in these two treatment groups due to flushing. The occurrence of higher twin birth might be correlated with higher BW gain in ewes that was observed in T_1 and T_2 due to the increased level of barley grain supplementation.

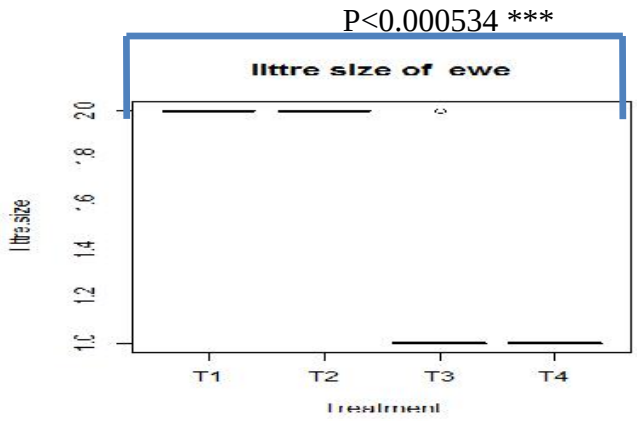

Fig. 6: Effect of flushing on litter size (T_1= natural pasture hay+350 g barley grain; T_2= natural pasture hay+287.5 g barley grain; T_3= natural pasture hay+2250 g barley grain and T_4= natural pasture hay only)

Pre weaning Lambs mortality

As it is shown in (Fig.7), out of 21 lambs born alive from four treatment groups, 12 lambs were died during the pre weaning period and only 9 lambs (4 lambs from T_1, 4 lambs from T_2 and 1 lamb from T_3) were weaned. Lambs mortality rate was (4.8%) in T_1 and T_2 and it was (19%) in T_3 and T_4. Out of the four lambs born under T_4 (control group) all of them were died during and after birth. Lambs mortality before weaning was high in all treatment groups, especially it was higher in T_3 and T_4 (control group) (Fig.7). One reason for death of lambs was, majority of ewes were reject their lambs and not let the new born to suckle. On the other hand increase in lamb's mortality under T_3 and T_4 (control group) might be an indication of effect of flushing on lambs' mortality.

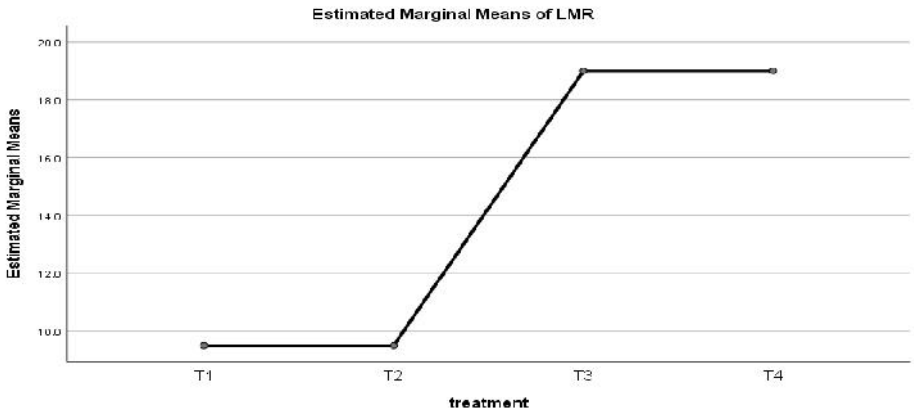

Fig. 7: Lamb mortality rate under all treatment groups (LMR= lamb mortality rate) (T_1= natural pasture hay+350 g barley grain; T_2= natural pasture hay+287.5 g barley grain; T_3= natural pasture hay+2250 g barley grain and T_4= natural pasture hay only)

Effect of Flushing on Body Weight of Dam and Lamb

The mean BW of Arsi- bale highland ewe measured before and after flushing is shown in Table 2. The current results show ewes under all treatment groups have related body weight before flushing. Significance (P>0.05) difference was not seen on body weight of dam before flushing. This confirmed that the animals allocated to four treatment groups have a similar BW on the onset of the study, while after flushing, the mean BW of dam under T_1 flushed by hay+350 g of barley grain per day showed a significant difference (P<0.05) than ewes under the remaining three treatment diets.

The effect of nutritional flushing on lamb birth weight is presented in (Table 2). The birth weights of lambs under T_1,T_2 and T_3 were not significantly (P>0.05) different; however, a significance (P<0.05) differences were seen between T_1 and T_4 in that the average birth weight of lamb under T_1 is higher (2.3 kg) than that of T_4 (1.8 kg), which could be an indicator to the higher nutritional supplementation (flushing) under T_1.

Table 2: Average body weight of dam before and after flushing

Parameters	Treatment				CV	Sig.
	T_1	T_2	T_3	T_4		
Dam weight before flushing (kg)	21.5±0.45	22.6±0.49	22.0±0.89	22.2±.1.17	3.70	0.17
Dam weight after flushing (kg)	25.0±0.54^{a}	23.8±.52^{ab}	23.2±.68^{ab}	22.5±.81^{b}	2.80	0.00
Lamb weight at birth (kg)	2.3±0.16^{a}	2.1±0.10^{ab}	2.03±0.18^{ab}	1.8±0.34^{b}	32.70	0.01
Lamb weight at weaning (kg)	11.3±.88	10.29±.51	9.9±.14	9.00	23.20	0.09

Different superscripts within a row differ at P<0.05; Sig. = significance level; T_1= natural pasture hay+350 g barley grain; T_2= natural pasture hay+287.5 g barley grain; T_3= natural pasture hay+225 g barley grain and T_4= natural pasture hay only.CV= coefficient of Variation

Discussion

Effect of Flushing on Conception rate:

Significance difference was not seen on conception rate among all treatment groups. The result obtained in current study is in agreement with the result of Huseyin *et al* (2006) and Bahaa (2019), which stated the conception rates of 83.33% and 100% for Akkaraman and Abou-Delik ewes, respectively. However, the present study results were higher than that of Ahmad *et al* (2022), Abdulkareem *et al* (2014) who reported the conception rate of Blackhead Somale and Awassi ewes, respectively was 70% and 66.6%.

Effect of Nutritional Flushing on Lambing rate:

Lambing rate was high in T_1 and T_2 than T_3 and T_4. All ewes under first two treatment group was give twin birth, but under T_3 and T_4 there is no twin birth at all. The result of Asfaw (2022) were, also indicate that the lambing rate of Doyogena ewe was 66.7%-100% and lambing rates of flushed groups were significantly higher than those of control group. The present study results were in agreement with the findings of Bahaa (2019) who reported the lambing rate of 100% when ewes were treated with flushing ration of 300 g of barley grain/head/day. In contrast, Sabra and Hassan (2010) reported a lower lambing rate of 80% than the present study when ewes treated with 500 g Sesbania (Sesbania grandiflora) dried forage.

Effect of Flushing on Abortion rate:

Abortion was slightly higher in T_1 and T_2, and occurred at the 3rd to 4th months of pregnancy. According to Abassa (1995), abortions mostly occur at the last stage of pregnancy in sheep. Very high rates of abortion and stillbirth were found among twin or triplet bearers and when primiparous (young animal) and immature females were bred. Ewe lambs bred between four and eight months of age not only suffered from higher abortions and stillbirths (55%) than adult ewes (14.6%), but also lost 89% of their progenies before one year of age. In the case of Arsi-Bale sheep breed, age at first lambing was 12.7 month (Tsedeke, 2007) and the present study results might be due to flushing the ewes too early.

Effects of Nutritional Flushing on Litter Size:

Twin birth was seen in T_1 and T_2, the twin birth in the T_1 and T_2 was an indication of increased ovulation rate in these two treatment groups due to flushing. Result of Asfaw (2022), also indicate as nutritional flushing increase litter size of Doyogena ewe in Doyogena district, southern Ethiopia.

Pre weaning Lambs mortality

Pre-weaning growth rate is from birth to 30 days of age. Lambs mortality before weaning was high in all treatment groups, especially it was higher in T_3 and T_4 (control group). Flushing should always practice before breeding so that it can increase the lamb weaning rate (Nanjing, 2023). Pre weaning lamb mortality can be also affected by parity. Lambs from second and third parity dams grew better than first and fifth parities (Tibbo, 2006; Taye *et al.*, 2009).

Effect of Flushing on body weight of dam and lamb:

The current results show ewes under all treatment groups have similar body weight before flushing, while after flushing, the mean BW of dam under T_1 was higher than other treatment groups. On the other hand, the birth weights of lambs under T_1 was higher (2.3kg) than control group T_4 (1.8kg), which indicate flushing can improve birth weight of lambs. The current result is lower than result of Asfaw (2022) indicating lamb birth weight is 2.73-2.93kg.

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I, the Corresponding Author, declare that this manuscript is original, has not been published before and is not currently being considered for publication elsewhere.

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Statements & Declarations

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