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Economic Benefits of Flushing and Supplemental Feeding of Salt-range Ewes on Pothwar Ranges of Pakistan

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Abstract: A supplemental feeding trial was conducted on yearly Salt-range ewes with a bodyweight of 26 -28 kg. Ewes grazed on a pasture dominated by *Heteropogon contortus, Dicanthium annulatum, Bothriochilora ishaeum* and *Artistida cyananthes* species of grasses. Chemical analysis showed that plant biomass contained more crude fibre (32±2.5 to 34±2.5) and less crude protein (3±1.5 to 6±1.7%) throughout the year. Dry matter percentage (air dry basis) remained almost the same (92±1.0). Supplement contained crude protein 16 and TDN 75%, respectively. Analysis of variance revealed that ewes at mating had lost 10-15% of initial bodyweight. However they gained bodyweight during late pregnancy with highest among ewes flushed and supplemented at CONTHS. During lactation ewes given supplement at CONTHS (74±40) rate gained more weight ($P<0.05$) than CONTLS (44±32 g/day). Ewes with CONT treatment lost bodyweight at a rate of 6 g/day through out the lactation. Fertility rate expressed as percentage of ewes conceived per group was 66.6 percent under CONT treatment, significantly lower ($P<0.01$) than 100% recorded under CONTLS and CONTHS treatments. Lambing percentage was almost 100% with 7% abortion in CONTLS supplemented ewes. Survival rate among lambs across the treatments was 100%. Lambs born to ewes flushed and supplemented at CONTHS (3.15±0.8 and 9.0±2.4 kg) excelled ($P<0.05$) to those under CONTLS (2.91±0.53 and 8.37±1.5) or without any treatment (2.6±0.5 and 7.65±1.7 kg) at birth and weaning at 45 days of lactation. Lambs suckling to ewes with CONTHS (131±48 g/day) also grew faster during lactation than CONT (112±41) but similar to those (131±48) of CONTLS. This will generate a reliable information which can be extended to farmers in interior Pothwar region.

Key words: Supplementation, reproductive performance, economic benefits

Introduction

Pothwar is one of the regions described as arid or semi arid constituting 68% of total land area of Pakistan. Due to low and erratic rainfall area has been converted into rangeland dominated by drought resistant species of grasses, shrubs and trees with variable grazing potential (Noor, 1988 and PARC, 1991). Mismanagement of these called rangelands due to indiscriminate grazing by sheep, goats and cattle (3, 51, 726; 12, 85, 407 and 10, 19, 053 heads) has further exacerbated the problem of low productivity of plant biomass.

As rainfall usually occurs during 2-4 months (Jan-Feb and July-August), major part of the year (8-10 months) remains dry with availability of succulent species of plants (Javed *et al.,* 1993 and Umrani *et al.,* 1995) composed of mainly cell wall contents (Wahid, 1990 and Narjissi, 1992). This type of vegetation supplies only 75 to 90% of dry matter requirements leading to loss in bodyweight of grazing animals (Butler-Hogg, 1984 and Birrell, 1989). This shortage of energy co-ncides with the start of reproductive cycle when ewes are required to have optimum body weight for a desirable ovulation rate (Thomson and Bahhady, 1988) or when nutritional requirements of ewes due to developing foetus during late gestation or flow of nutrients through milk suckled by lambs are increased (ARC, 1990 and Demeke *et al*., 1995). Early findings of Rafiq *et al.* (1990); Helali *et al.* (1990) and West *et al.* (1991) have shown that malnutrition during mating season, late gestation and early lactation not only lowers ovulation/fertility rate, reduces size of foetus but also growth rate. Under these circumstances it becomes imperative to supplement ewes so that not only ovulation rate is improved but also lamb's birth weight, growth and survival rate during early lactation (Rafique *et al*., 1991 and Khan *et al*., 1992). Supplementation with appropriate sources of energy and N have been found to improve not only voluntarily intake but also productive and reproductive performance in ruminants (Kempton, 1982 and Rafiq, 2000).

The primary objective of this study was to measure the

effect of low or high level of flushing/supplementation on fertility rate, changes in body weight of ewes, their effect on growth rate of lambs and subsequent economic benefits to the farmers.

Materials and Methods

Location: The study was conducted during 1990-91 at National Agricultural Research Centre (NARC), Islamabad. The climate of region is sub humid with a rainfall of 150 to 350 mm/annum mainly during January and August. Mean temperature has been reported from 25°C during winter to 42°C during summer. Vegetation available at NARC is mainly composed of grass species.

Plant biomass production: A pasture comprising on 6 paddocks each of 1 ha, was subjected to grazing at random. In order to identify plant species composing biomass and subsequent changes in chemical composition during various seasons 10 samples of plant biomass were taken randomly using quadrate method (1 sqm), air dried and analyzed for dry matter (DM), N, crude fibre, ether extract and ash percent (AOAC, 1984). Similarly concentrate purchased from Feed Technology Centre at NARC and used as supplement was analyzed for DM, N and total digestible nutrients (TDN) using method of AOAC (1984).

Animals: During the last week of August 1990, 42 yearling ewes of Salt-range breed (26-28 kg live weight) were divided into 3 groups each of 14 and assigned randomly to the treatments of (1) grazing on pasture (control, CONT), (2) CONT plus supplement at low level (CONTLS) or (3) at a higher level (CONTHS) as flushing and supplementation during premating, late gestation and early lactation.

Flushing and supplemental feeding: Animals assigned to treatments of 2 and 3 were flushed for period of 60 days so that at least 3 oestrous cycles are covered. Ewes were supplemented for 60 days during late gestation and 45 days during early lactation. Animals assigned to CONTLS and CONTHS were flushed and supplemented during late gestation and early lactation at rate of 200 and 400 g per day.

Breeding management: After one month of start of flushing 2 rams fixed with colours were introduced in whole flock of 42 ewes. Rams remained in flock for a period of 12 to 16 hours/day. This practice continued for a period of 60 days so that maximum ewes were served.

Weighing management: Ewes were weighed at the start of experiment/flushing/supplementation, mating, lambing, weaning and fortnight intervals. Similarly lambs were weighed at birth, at fortnight intervals during lactation and at weaning.

Statistics: Data on improvement in reproductive performance, changes in live weight of ewes and growth of lambs was subjected to analysis of variance using General Linear Model (GLM) Program (Mimitab, version 1). Significant differences in treatment means were tested using Least significant difference (LSD) procedures as Steel and Torrie (1980).

Economic analysis: Improvement in fertility rate among ewes and growth of lambs suckling to ewes with or without supplemental feeding was subjected to economical analysis using methods described by Perrin *et al.* (1980), Gittinger (1982) and Chaudhry and Longmire (1989).

Results

Climatic conditions: Mean temperature (°C) started declining from 31 during mating season to 17 in last trimester of gestation and 23 at the start of early spring coinciding with lambing.

Mean rainfall recorded during the gestation period was 64 (Oct. to Dec., 1990) compared with 106 mm during early lambing (1991). The percentage of relative humidity recorded at 8. am and 2. pm of the day during (Oct. to Dec.) was 78.6 and 53%. Percentage of relative humidity during (Jan. to Mar). quarter was 86 and 52, respectively. Analysis of plant biomass indicated that vegetation at NARC paddocks was dominated by Heteropogon contartus, Dicarthium annulatum, Bothriochlora ishaeum and Aristida cyananthes grass species.

Chemical composition of plant biomass: Grass species contained a significant percentage of crude fibre than other components of nutritional importance. The percentage of crude fibre was highest in grass samples collected in late winter than those collected either in summer or spring. Contents of Crude protein were highest in samples collected in summer but non significantly (Table 1).

Table 1 also shows that concentrate used as a supplement contained 16% crude protein and 75% total digestible nutrients (TDN).

Changes in bodyweight of ewes: All the ewes assigned to either CONT or CONTLS and CONTHS were almost uniform in size at the start of experiment. As shown in Table 2 ewes had lost bodyweight at mating but at a same

Table 1: Mean±SD of chemical composition (%) of plant biomass of pasture at NARC

	Seasons		
Parameters	Summer	Winter	Spring
Number of samples	10	10	10
Dry matter	92.2±0.6	92.2±1.2	92.1±0.6
Crude protein	6.2±1.7	3.0±1.5	3.4±0.7
Crude fibre	32.1±2.5	34.8±2.8	34.2±2.5
Ether extract (EE)	1.9±0.1	1.7±0.8	1.9±0.6
Nitrogen free extract (NFE)	49.9±4.0	54.0±4.0	53.3±4.5
Ash	10.1±2	9.4±1.4	8.1±2.8

Table 2: Mean±SD of reproductive performance of Salt-range ewes at NARC

	Treatments		
Parameters	Cont	Contls	Conths
Initial live weight of ewes (kg)	27.9±3.8	26.4±3.2	28.2±3.0
Live weight of ewes at mating (kg)	27.3±3.0	26.2±3.5	27.2±3.4
Live weight of ewes at advance gestation (kg)	27.7±3.3	28.2±3.5	28.3±3.1
Fertility rate (%)	64.3	100	100
Abortion rate (%)	--	7	--
Number of lambs born	9	13	14
Number of lambs weaned	9	13	14
Lamb survival rate (%)	100	100	100

Table 3: Mean±SD of production traits in lambs sucking to Salt-range ewes at NARC

	Treatments		
Parameters	Cont	Contls	Conths
Live weight of ewes at lambing (kg)	24.0±3.5	24.5±3.8	26.6±2.5
Live weight of ewes at weaning (kg)	23.8±2.4	26.5±3.4	29.7±3.8
Live weight gain of ewes (g/day)	5.5±0.6c	44.0±32.0ab	74.5±40.0a
Birth weight of lambs (kg)	2.6±0.56bc	2.91±0.5ab	3.1±0.8a
Weaning weight of lambs (kg)	7.6±1.7c	8.37±1.5ab	9.0±2.4a
Live weight gain of lambs (g/day)	112.0±41b	130.9±48.0a	131.4±48.5a

±Standard deviations.

Table 4: Mean±SD of partial budget of flushing and supplemental feeding of ewes grazing on range-land

	Treatments		
Parameters	Cont	Contls	Conths
No. of ewes	14.0	14.0	14.0
Fertility rate (%)	64.3	100.0	100.0
Abortion rate (%)	0.0	7.0	0.0
No of lambs born	9.0	13.0	14.0
Lamb survival rate (%)	100.0	100.0	100.0
Benefits			
Total lamb weight (kg)	68.9	108.8	126.0
Gross benefits (Rs)	3789.5	5984.0	6930.0
Benefits/ewe (Rs)	270.7	460.3	495.0
Cost that varies			
Total feed consumed (kg)	-	429.3	924.0
Total feed cost (Rs)	-	2145.0	4620.0
Feed cost/ewe (Rs)	-	165.0	330.0
Net benefits/ewe (Rs)	270.7	295.3	165.0
Marginal rate of return (%)	-	149.0	-32.0

CONT: Range-land grazing only/farmer's practice.
CONTLS: Range-land grazing plus feed supplementation @ 200g/day
CONTHS: Range-land grazing plus feed supplementation @ 400g/day
Feed Price: Rs 5.00/kg; lamb live-weight sale price: Rs. 55/kg
1 US$: Rs. 17.0

rate with highest among ewes given CONTHS treatment. At a stage of advance gestation ewes supplemented at CONTLS level gained weight at a highest rate ($P < 0.05$) followed by CONTHS and CONT.

Reproductive performance of ewes: Fertility rate expressed as percentage of ewes conceived per group of 14 was highest ($P < 0.01$) among ewes flushed at CONTLS and CONTHS rate. However 7% abortion rate was recorded among ewes given CONTLS treatment. Percentage of lambs survived at weaning was almost similar across the treatments (Table 2).

Analysis of variance also revealed non significant differences in live weight of ewes recorded at lambing. However, live weight of ewes recorded at weaning differed significantly ($P<0.05$). Ewes assigned to CONTHS were heavier followed by CONTLS and CONT. Rate of weight gain from lambing to weaning was highly variable ($p < 0.01$). Ewes receiving supplement at a rate of CONTHS gained at a higher rate ($P < 0.01$) than those supplemented at CONTLS whereas ewes grazing on rangelands lost live weight.

Growth performance of lambs: Lambs born to ewes supplemented at CONTHS or CONTLS were significantly heavier ($P < 0.05$) than those maintained on rangeland only (CONT). Weaning weight and rate of growth of lambs suckling to ewes supplemented at the rate of CONTLS and CONTHS was similar but greater ($P < 0.05$) than those on CONT treatment (Table 3).

Economic analysis: Table 4 shows that supplementation at a rate 200 g/day was most economical intervention under existing environment. The marginal rate of return (MRR) changing from farmer's practice of no supplementing feed as shown in treatment CONT to the adaptation of new practice of feed supplement CONTLS implies a return of 15% from investment in feeding while CONTHS rate of supplementation implies a loss of 32% profit.

Discussion

Reproductive performance of ewes: Since pasture and grazing management was same for all groups of ewes therefore intake of dry matter is assumed to be similar. Whatsoever differences in the performance of sheep have been observed are due to supplemental feeding. A 64 to 106 mm rainfall could not lead a growth of vegetation which could last for a full production cycle. Limited rainfall had led to the growth of coarse and succulent species of grasses with relatively higher proportion of crude fibre. This could not support animals throughout the production cycle.

Early reviews of Rattray and Jagusch (1978) have shown that sword height and leave availability characteristics of plant vegetation at maturity are factors affecting herbage quality and intake by animals. As a result of plant maturity concentration of metabolizable energy (M/D ME) declines to the extent lower than required by animals (8.39-9.68 MJ/ME/kg DM). This 8.39-9.68 MJ/ME/kg DM is lower than 10-12 recommended for flushing ewes. This low intake of ME than recommended level lowers bodyweight required for an optimum ovulation and fertility rate (Thomson and Bahhady, 1988). In order to avoid situation of malnutrition during breeding season Treacher (1990) recommended building of reserves of good quality herbage for the maintenance of ewes intake prior and during mating. His findings coincided with Morris *et al.* (1994) that changes in ewe live weight, wool growth and lamb production are related to herbage allowance. In addition to stage of maturity higher proportion of weed and dead material as found in our paddocks is also reported to restrict access to green herbage in the 2.0 and 4.0 cm sword and becomes a contributing factor in lowering intake by sheep with negative effects on its performance (Burnham *et al.*, 1994).

As a result of poor voluntary feed intake and subsequent live weight ovulation rate was low and resulted in lower fertility of 64.3% in ewes maintained on grazing (CONT) an observation consistent with ones recorded by Thomson and Bahhady (1988). When ewes were flushed whether at CONTLS or CONTHS, fertility rate increased from 64.3 to 100% in both groups. This was due to stimulating effects of supplements which were not only improved intake and digestion (Hatfield *et al.*, 1990) but also fertility (Meyer1985; Rafiq *et al.*, 1990-91; West *et al.*, 1991 and Khan *et al.*, 1992). These researchers had reached to the conclusion that if moderately underweight ewes are flushed then 10-20% more lambs can be expected which supports our data given in Table 2.

Changes in live weight of ewes: Ewes regardless the flushing treatment lost bodyweight during the breeding season of almost two months. This loss was more in live weight of ewes flushed at CONTHS than either at CONT or CONTLS which might be due to imbalance ratio between energy and N supplied by higher level of dietary supplement (Leng, 1990). However loss in bodyweight was recovered during gestation. Pattern of increase in bodyweight of ewes was almost similar regardless the

treatments which might be due to development of foetus (ARC, 1990 and Forgarty *et al*., 1992). In spite of supplementation during late gestation ewes lost body weight, almost 10 to 15% of initial weight. This loss in bodyweight was almost greater in CONT than CONTLS and CONTHS groups. This indicates that supplemental feeding minimized the losses in bodyweight through higher intake of digestible organic matter (Dixon *et al*., 1992). Observations recorded by Ronchi *et al*. (1993) also support our data on live weight that ewes during late pregnancy require high energy diets. Findings of Holst and Allan (1992) revealed similar changes in bodyweight of ewes when supplemented during advance gestation.

Response of sheep to supplementation was more pronounced during lactation than in late gestation. Ewes maintained on rangeland only (CONT) lost bodyweight. Whereas ewes supplemented with CONTHS gained bodyweight at a higher rate than CONTLS. This gain in bodyweight is consistent with that recorded by Demeke *et al*. (1995). These workers concluded that genotype and supplementation have a significant effect on post natal ewe bodyweight. Salt-range sheep having poor nutritional status responded well to supplementation with appropriate sources of energy and N particularly during lean season-an observation supported by Cheema *et al*. (1996). This also coincides with findings of Brookes *et al*. (1998) that ewes demand more feed during late pregnancy and lactation till weaning. However similar performance of ewes supplemented at either CONTLS or CONTHS is speculated as imbalance between energy and protein in dietary supplements (Leng, 1990).

Growth performance of lambs: Birth weight is a critical factor affecting lamb production through mortality, morbidity and survival rate. High birth weights are associated with dystocia and low birth weight with starvation (Scales *et al*., 1986). In view of these factors birth weight recorded on Salt-range lambs seems to be an optimum when compared with other native breeds or regional ones.

Differences observed in birth weight of lambs born to either ewes on CONT or those on CONTLS and CONTHS treatments are mainly related to size, nutritional status and subsequent performance of their dams with or without supplemental feeding. As shown in Table 3 ewes with CONTHS weighed heaviest during last quarter and delivered lambs with higher weight than either CONTLS or CONT (Table 4). These differences in birth weight of lambs born to Salt-range ewes on CONT are in line with those of reported by Cheema *et al*. (1996). Since their level of supplementation offered to ewes was higher subsequent lambs were heavier than on control treatment. Findings of Rafique *et al*. (1996) recorded on birth weight of lambs born to Baluchi ewes under grazing conditions are in line with our data. Since all ewes were maintained on uniform grazing regimens therefore differences observed in birth weight are mainly due to supplements offered to differences in nutritional status of dams (Cooper *et al*., 1998). The birth weight of lambs is also consistent when compared with regional breeds of Nali (Singh *et al*., 1987), Deccani (Fernandes and Deshmukh, 1988) in India and Chios found in Cybres (Mavrogenis, 1988).

Differences in weaning weight and rate of weight gain in lambs have also contributed by supplemental feeds with desirable effects on milk production (Muir *et al*., 1998). These differences in performance of lambs during lactation are consistent with those reported by Cheema *et al*. (1996). Rafique *et al*. (1991,96) also recorded similar weight gains in Baluchi lambs under rangeland conditions of Baluchistan. These workers concluded that supplemental feeding can improve birth and weaning weight of lambs and lower postnatal mortality through higher immunity. These observations on improvement in birth weight and weaning weight are agreement with those recorded by Al-Nakib *et al*. (1996). Findings of Ahmed and Rehman (1996) support our data on birth weight, weaning weight and survival rate among lambs of Salt-range breed although under better feeding conditions than in our experiment.

Economic analysis: Based on performance of ewes given supplement and subsequent growth of lambs (Table 4) supplemented at CONTLS rate was the most economical one. As mentioned earlier main reason speculated was imbalance between energy and N when offered a higher level of supplement composed of cereal grains and molasses like that of Cattle feed available at NARC Feed Mills. These economical aspects of gains coincide with early findings of Rafiq *et al*. (1991) and Cheema *et al*. (1996).

Low fertility rate, losses in bodyweight of ewes during lactation and poor growth of lambs clearly indicate that ranges are not in position to support economical production. In order to have an economical level of production under rangeland conditions supplementation with appropriate sources of energy and N is imperative. Although results of the above analysis indicate that farmers would gain on their investment by adopting low feed supplementation yet immediate recommendation cannot be made on the basis of one year data. In order to generate a reliable data further investigations are in progress.

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