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Effect of Improved Nutrition and Improved Shelter on Pre and Post Weaning Growth Performance of Magra Lambs in Two Lambing Seasons under Arid Zone

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ABSTRACT

The present experiment was conducted in phased manner to observe the effect of improved nutrition and improved shelter either alone or in combination on pre and post weaning growth performance in Magra lambs. In phase-I, fifteen days old Magra lambs (n=40) born in autumn-winter season were used for growth study in a randomized block design upto the six month of age i.e. preweaning stage from 15 days to 3 months of age and thereafter post weaning stage up to 6 months of age (Season-1) at ARC-CSWRI and divided into four groups of 10 lambs in each group (T_1-T_4). In Phase-II, similar experiment was followed with the lambs born in spring-summer season (Season-II). Groups included T_1-Sole grazing with traditional shelter (tree shade); T_2-improved shelter (asbestos sheet-thatched roof/with curtains) with grazing; T_3-improved nutrition and traditional shelter and T_4-improved nutrition and improved shelter. In groups of (T_3-T_4) varying plane of nutrition was supplemented with creep mixture @1% of their body weight from 15 days of age to weaning while multinutrient mixture @1% of their body weight was provided during postweaning stage upto six month of age in both seasons. There was diurnal variation in temperature and THI during the study period, which indicated that lambs were under thermal stress during various months of trial. Environmental stress coupled with nutritional stress reduce growth rate in control group (T_1) which might be improved by provision of improved nutrition and shelter.

HIGHLIGHTS

- Effect of improved nutrition and improved shelter either alone or in combination on pre and post weaning growth performance in Magra lambs.
- Environmental stress coupled with nutritional stress reduce growth rate in Magra lambs might be improved by provision of improved nutrition and shelter.

Keywords: Pre weaning growth, post weaning growth, improved nutrition, improved shelter, Magra

Management of small ruminants on pasturelands is challenging as these are characterized by inherently low and variable precipitation, in arid regions of Rajasthan. Feed expenditure is maximum, accounting for 70% or more of total production costs in raising small ruminants. Nutrition exerts a very large impact on lamb and kid growth,flock reproduction and milk production of dams. Kids and lambs with higher growth potential have higher nutritional needs. Creep feeding and supplemental feeding of lambs and kids are practiced to achieve high early growth and early finishing weight. Requirements of

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nutrients will be high when environmental temperatures rise above 70ºF. Ruminants in arid region of Rajasthan depend largely on crop residues for maintenance as well as production of meat, milk, skin and fibre, at least during the long dry periods of the year. Forage fibre with high digestibility at early post-weaning stage at low levels may favour optimum rumen function, more nutrient supply from diet and continuous better growth in post-weaning lambs as compared to traditional practice of feeding high roughage diet immediately after weaning (Raju, 2019). Supplementation of concentrate feed in addition to grazing provides additional nutrients to support rapid growth rate in lambs (Chellapandian, 2016). Productivity of livestock is substantially increased through shelter management. Srivastav (2019) reported that thatch roof prevents solar radiations and creates more comfortable micro environment inside the shed which result in better growth performance as compared to tin sheet and tree shed. There are a number of factors that significantly affect body weight of lambs at birth and weaning such as year and season of lambing, type of birth and sex of lamb (Albial *et al.,* 2014). Moreover, due to nutritional and environmental stress animal's productivity is severely affected which result great economic loss for the sheep industry.

MATERIALS AND METHODS

Phased experiment was conducted on 15 days old male Magra lambs at the sheep farm of ARC-CSWRI, Bikaner. In phase-I, fifteen days old Magra lambs (n=40) born in autumn-winter season were used for growth study in a randomized block design upto the six month of age, i.e. preweaning stage from 15 days to 3months of age and thereafter post weaning stage up to 6 months of age (Season-1) i.e. from September 2016 to February-March 2017 at ARC-CSWRI and divided into four groups of ten lambs in each group (T_1-T_4). In Phase-II, similar experiment was followed with the lambs born in spring-summer season (Season-II)i.e. from February 2017 to August 2017. Groups included T_1-Sole grazing with traditional shelter; T_2-improved shelter with grazing; T_3-improved nutrition and traditional shelter and T_4-improved nutrition and improved shelter. The traditional shelter means an enclosure without roof structure under tree shade. Improved shelter was in the form of asbestos sheet-thatched roof. Additional protection was provided with curtains in winter period to save the lambs from direct cold waves. In groups of (T_3-T_4) varying plane of nutrition was supplemented with creep mixture @1% of their body weight from 15 days of age to weaning while multinutrient mixture @1% of their body weight was provided during postweaning stage upto six month of age in both seasons. Lambs were kept in their respective sheds with their dams upto weaning and thereafter they were separated from their dams and let loose for 8 hours grazing in all groups. The lambs of all groups were supplemented with *ad lib* groundnut fodder during the whole trial. All experimental lambs reared under strict management and proper hygienic conditions throughout the study period. Deworming was carried out for both ecto and endoparasites using suitable anthelmintics before the beginning of the experiment. A digital data logger was used to record air temperature and relative humidity inside and outside of the shed. The data logger was hanged at 1.5 meter above the ground in the middle of inside and outside the shed. Climatic variables were observed during whole trial. THI values were calculated from recorded meteorological variables by formula given by Marai *et al.* (2007). The body weight was recorded at weekly intervals before feeding and watering. Individual body weight of all the lambs were recorded with hanging digital balance on the first day of the experiment and thereafter, regularly at weekly interval in both preweaning and postweaning stage. The weekly body weight gain was calculated by difference between weight recorded during the present and previous week. Average daily gain (ADG) in grams was estimated by dividing the total body weight gain by number of days. Preweaning and postweaning growth was observed in both seasons. The data obtained in the present experiment were analyzed statistically for main effect of treatment or season alone as well as interaction (Treatment × Season) in factorial design (4*2) as per Snedecor and Cochran (2004) and significance of mean differences was tested by Duncan's New Multiple Range Test (DNMRT) as modified by Kramer (1956).

RESULTS AND DISCUSSION

The monthly mean values of average temperature, relative humidity and temperature humidity index (THI) of different months of inside and outside shed of both seasons are presented under in Table 1. The monthly mean values of temperature, relative humidity and THI of daytime (7 a.m.-7 p.m.) and night time (7 p.m.-7 a.m.)

Table 1: Monthly mean values of temperature, relative humidity and THI of season 1 and 2 (inside and outside shed)

Period (months)	Average temperature (ºC)		Average relative humidity (%)		Average THI	
	In	Out	In	Out	In	Out
Season 1						
September	31.65	32.33	49.63	49.16	28.94	29.49
October	27.80	27.81	44.83	45.64	25.56	25.60
November	19.31	19.01	43.27	44.95	18.45	18.22
December	18.76	17.87	48.62	48.05	18.06	17.31
January	14.73	12.84	65.30	65.51	14.72	13.02
Feb.-Mar. (up to 5th march)	18.59	20.19	42.91	39.07	17.74	19.05
Season 2						
February (From 12th Feb.)	20.64	21.88	33.65	33.47	19.16	19.95
March	25.26	26.15	33.43	33.83	22.96	23.67
April	32.84	33.31	23.45	23.80	28.47	28.84
May	34.96	34.93	32.41	33.82	30.61	30.66
June	34.44	34.52	49.43	49.63	31.26	31.32
July-Aug (Up to 12th Aug.)	32.58	32.44	59.47	59.50	30.29	30.17

Table 2: Monthly mean values of temperature, relative humidity and THI of day and night of season 1 and 2 (inside and outside shed)

Period (months)	Temperature (ºC)				Relative humidity (%)				THI			
	Day		Night		Day		Night		Day		Night	
	In	Out	In	Out	In	Out	In	Out	In	Out	In	Out
Season 1												
September	35.06	37.01	28.22	27.67	40.90	37.86	58.38	60.44	31.24	32.58	26.42	26.02
October	30.72	31.32	24.81	24.23	37.88	37.82	51.84	53.55	27.54	28.01	23.23	22.78
November	20.44	21.04	18.18	16.97	41.50	41.39	45.06	48.52	19.34	19.82	17.53	16.55
December	23.17	24.96	14.30	10.73	37.65	33.72	59.85	62.64	21.39	22.65	14.30	11.13
January	17.95	17.24	11.48	8.39	58.26	54.83	72.45	76.32	17.44	16.78	11.71	8.82
Feb.-Mar. (Up to 5th March)	20.92	24.35	16.27	16.04	37.95	31.66	47.83	46.44	19.65	22.20	15.95	15.77
Season 2												
February (From 12th Feb.)	23.17	25.38	18.11	18.39	27.87	25.90	39.43	41.04	21.09	22.63	17.22	17.27
March	29.06	31.52	21.52	20.84	26.17	24.62	40.65	42.98	25.68	27.47	20.19	19.68
April	37.14	38.90	28.54	27.71	18.18	17.22	28.79	30.44	31.35	32.59	25.40	24.81
May	38.90	39.14	30.97	30.68	25.61	27.24	39.44	40.60	33.23	33.55	27.84	27.66
June	37.28	37.84	31.60	31.20	41.98	41.50	56.91	57.80	33.14	33.56	29.29	28.99
July-Aug (Up to 12th Aug.)	34.54	34.87	30.61	30.00	52.56	52.17	66.39	66.83	31.56	31.82	28.91	28.39

during different months of inside and outside shed of both seasons have been presented in Table 2. The formulated creep mixture and multinutrient mixture were analysed for proximate composition as per AOAC, (2005). The per cent composition (% DM) of experimental feed mixtures has been tabulated in Table 3. The mean values of phase wise and overall body weight gain of whole study period of lambs under different treatment groups have been presented in Table 4. Due to main effect of treatment, the mean values of body weight gain in different treatment groups were recorded to be 9.04±0.23 kg in T_1, 9.30±0.19 kg in T_2, 11.46±0.29 kg in T_3 and 11.83±0.33 kg in T_4 group during pre-weaning stage, while, 4.23±0.28 kg in T_1, 4.79±0.27 kg in T_2, 6.19±0.27 kg in T_3 and 6.63±0.27 kg in T_4 during post-weaning stage. Whereas, mean values of overall body weight gain were recorded to be 13.27±0.26 kg, 14.09±0.26 kg, 17.66±0.43 kg and 18.46±0.43 kg in T_1, T_2, T_3 and T_4 groups, respectively. Likewise, as a resultant to the main effect of season, the mean values of body weight gain of lambs in season 1 and season 2

Table 3: Proximate composition of experimental mixture and commercial pellets (% DM basis)

Sl. No.	Proximate principle	Creep mixture	Multinutrient mixture
1	Dry matter	92.51	86.38
2	Crude protein	18.23	17.61
3	Ether extract	04.20	01.87
4	Crude fibre	05.20	03.35
5	Total ash	6.09	14.43
6	Nitrogen free extract	57.80	58.96

Table 4: Effect of different treatment groups on body weight gain (kg) of lambs in different phases in two lambing seasons

		Period (Phases)		
Treatment groups		**Pre-weaning**	**Post-weaning**	**Overall**
		Interaction (Treatment × Season)		
Treatment	**Season**			
T_1	1	9.01±0.42	3.49±0.45	12.51±0.14
T_2	1	9.16±0.29	4.13±0.39	13.29±0.23
T_3	1	11.19±0.53	5.43±0.39	16.61±0.61
T_4	1	11.56±0.64	5.66±0.28	17.22±0.61
T_1	2	9.07±0.23	4.89±0.19	13.95±0.35
T_2	2	9.44±0.25	5.45±0.26	14.89±0.29
T_3	2	11.74±0.24	6.96±0.18	18.70±0.39
T_4	2	12.10±0.17	7.59±0.14	19.70±0.27
Main effect of Treatment				
T_1		9.04^a ±0.23	4.23^a ±0.28	13.27^a ±0.26
T_2		9.30^a ±0.19	4.79^a ±0.27	14.09^a ±0.26
T_3		11.46^b ±0.29	6.19^b ±0.27	17.66^c ±0.43
T_4		11.83^b ±0.33	6.63^b ±0.27	18.46^d ±0.43
Main effect of Season				
Season 1 (S1)		10.26±0.30	4.71^a ±0.23	14.97^a ±0.40
Season 2 (S2)		10.59±0.24	6.22^b ±0.20	16.81^b ±0.42

Means with different superscripts in a column differ significantly.

were recorded to be 10.26± 0.30 kg and 10.59±0.24 kg during pre-weaning phase, while, 4.71±0.23 kg and 6.22±0.20 kg during post weaning phase. Whereas, the mean values of overall body weight gain were recorded to be 14.97±0.40 kg in season 1 and 16.81±0.42 kg in season 2. The effect of season to various treatments (Treatment x Season) was also taken into consideration, the mean values of body weight gain of lambs in season 1 and season 2 were recorded to be 9.01±0.42 and 9.07±0.23 kg in T_1, 9.16±0.29 and 9.44±0.25 kg in T_2, 11.19±0.53 and 11.74±0.24 kg in T_3, 11.56±0.64 and 12.10±0.17 kg in T_4 during pre-weaning stage, while, 3.49±0.45 and 4.89±0.19 kg in T_1, 4.13±0.39 and 5.45±0.26 kg in T_2, 5.43±0.39 and 6.96±0.18 kg in T_3 and, 5.66±0.28 and 7.59±0.14 kg in T_4 during post weaning stage. Whereas, the mean values of overall body weight gain of lambs in season 1 and season 2 were recorded to be 12.51±0.14 and 13.95±0.35 kg in T_1, 13.29±0.23 and 14.89±0.29 kg in T_2, 16.61±0.61 and 18.70±0.39 kg in T_3 and, 17.22±0.61 and 19.70±0.27 kg in T_4 group. Statistical analysis of variance due to main effect of treatment revealed highly significant ($P<0.01$) effect on the average body weight gain of lambs during both phases as well as on overall body weight gain. Likewise, statistical analysis of variance due to main effect of season revealed highly significant ($P<0.01$) effect during post-weaning phase as well as on overall body weight gain but remained non-significant during pre-weaning phase. The statistical analysis of variance for interaction (Treatment × Season) revealed no significant effect during whole trial. During the pre-weaning phase, due to main effect

of treatment, highest per cent (30.90%) increase in body weight gain was recorded in lambs of group T_4 followed by 26.77 % in T_3, 2.88 % in T_2 over control, while, during post weaning stage, highest per cent (56.74%) increase in body weight gain was recorded in lambs of group T_4 followed by 46.33 % in T_3, 13.24 % in T_2 over control. At the end of experiment, the highest per cent (39.11%) increase in overall body weight gain in group T_4, followed by 33.08 % in T_3, 6.18% in T_2 over T_1 (control). Likewise, due to main effect of season, during the pre-weaning stage, 3.22% increase in body weight gain was recorded in lambs of season 2 over season 1, while during the post-weaning stage, 32.05% increase in body weight gain was recorded in lambs of season 2 over season 1. At the end of experiment, 12.29% increase in overall body weight gain was noticed in season 2 over season 1 due to main effect of season. The mean values of phase wise and overall average daily gain of lambs under different treatment groups of experiment have been presented in Table 5. Due to main effect of treatment, the mean values of average daily gain of lambs were recorded to be 117.44±2.94 g in T_1, 120.78±2.43 g in T_2, 148.87±3.76 g in T_3 and 153.68±4.26 g in T_4 during pre-weaning stage, while, 46.45±3.11 g in T_1, 52.64±3.02 g in T_2, 68.06±2.98 g in T_3 and 72.83±2.97 g in T_4 during post-weaning stage, whereas, the mean values of overall average daily gain of lambs were recorded to be 81.94±1.50 g, 86.71±1.47g, 108.46±2.57 g and 113.25±2.64 g in T_1 (Control), T_2, T_3 and T_4 groups, respectively. Likewise, as a resultant to the main effect of season, the mean values of average daily gain of lambs during season 1 and season 2 were recorded to be 133.27±3.90 g and 137.51±3.13 g during pre-weaning phase, while, 51.76±2.56 g and 68.36±2.19 g during post-weaning phase. Whereas, the mean values of average daily gain of lambs of whole study period were recorded to be 92.51±2.43 g during season 1 and 102.94±2.55 g during season 2. The effect of season to various treatments (Treatment × Season) was also taken into consideration, the mean values of average daily gain of lambs during season 1 and season 2 were recorded to be 117.06±5.43 g and 117.77±3.04 g in T_1, 118.95±3.74 g and 122.60±3.19 g in T_2, 145.27±6.84 g and 152.46±3.13 g in T_3, 150.15±8.32 g and 157.20±2.16 g in T_4 group during pre-weaning phase, while, 38.40±5.00 g and 53.69±2.12 g in T_1, 45.41±4.33 g and 59.87±2.84 g in T_2, 59.65±4.23 g and 76.46±1.97 g in T_3 and, 62.22±3.12 g and 83.43±1.55 g in T_4 during post-weaning phase. Whereas, the mean values of average daily gain of lambs during whole period of study were recorded to be 77.73±0.83 g in T_1 (Control),

Table 5: Effect of different treatment groups on average daily gain (g) of lambs in different phases in two lambing seasons

		Period (Phases)		
Treatment groups		**Pre-weaning**	**Post-weaning**	**Overall**
		Interaction (Treatment x Season)		
Treatment	**Season**			
T_1	1	117.06±5.43	38.40±5.00	77.73±0.83
T_2	1	118.95±3.74	45.41±4.33	82.18±1.27
T_3	1	145.27±6.84	59.65±4.23	102.46±3.75
T_4	1	150.15±8.32	62.22±3.12	106.19±3.95
T_1	2	117.77±3.04	53.69±2.12	85.73±2.15
T_2	2	122.6±3.19	59.87±2.84	91.23±1.73
T_3	2	152.46±3.13	76.46±1.97	114.46±2.39
T_4	2	157.20±2.16	83.43±1.55	120.32±1.66
Main effect of Treatment				
T_1		117.44^a ±2.94	46.45^a ±3.11	81.94^a ±1.50
T_2		120.78^a ±2.43	52.64^a ±3.02	86.71^a ±1.47
T_3		148.87^b ±3.76	68.06^b ±2.98	108.46^b ±2.57
T_4		153.68^b ±4.26	72.83^b ±2.97	113.25^b ±2.64
Main effect of Season				
Season 1 (S1)		133.27±3.90	51.76^a ±2.56	92.51^a ±2.43
Season 2 (S2)		137.51±3.13	68.36^b ±2.19	102.94^b ±2.55

Means with different superscripts in a column differ significantly.

82.18±1.27 g in T_2, 102.46±3.75 g in T_3, 106.19±3.95 g in T_4 during season 1 and 85.73±2.15 g in T_1 (Control), 91.23±1.73 g in T_2, 114.46±2.39 g in T_3, 120.32±1.66 g in T_4 group during season 2. Statistical analysis of variance due to main effect of treatment revealed highly significant ($P<0.01$) effect on the average daily gain of lambs during both phases as well as on average daily gain of whole period of study. Likewise, due to main effect of season revealed highly significant ($P<0.01$) effect during post-weaning phase and on average daily gain of whole period of study but remained non-significant during pre-weaning phase. The statistical analysis of variance due to interaction (Treatment x Season) revealed no significant effect during whole trial. Due to main effect of treatment during pre-weaning stage, the highest per cent (30.86%) increase in average daily gain was recorded in lambs of group T_4 followed by 26.76% in T_3, 2.85 % in T_2 over control while, in the post weaning phase, the highest per cent (56.79 %) increase in average daily gain was recorded in lambs of group T_4 followed by 46.52 % in T_3, 13.33% in T_2 over control. Whereas, during whole period of study, the highest per cent (38.21%) increase in average daily gain of group of T_4, followed by 32.37% in T_3, 5.82 % in T_2 over T_1 (control). Due to main effect of season in the pre-weaning phase, the per cent (3.18%) increase in average daily gain was recorded in lambs of season 2 over season 1, while during the post-weaning phase, the per cent (32.07%) increase in average daily gain was recorded in lambs of season 2 over season 1. Whereas, 11.27% increase in average daily gain was noticed in whole period of study in season 2 over season 1.

Results of present findings showed that the calculated temperature humidity index (THI) for both seasons was observed to be in wide variation, which were either higher or lower than recommended values *i.e.*<22.2 is absence of heat stress, 22.2 to < 23.3 is moderate heat stress, 23.3 to< 25.6 is severe heat stress and 25.6 and more is extreme severe heat stress as reported for sheep by Marai *et al.* (2007).Looking into the results of meteorological variables of day-night (Table 2) it is indicated that there was diurnal variation in temperature and THI, when animals were exposed to severe climatic stress in almost all daytime hours in extreme summer and in almost all night time hours during extreme winter. Wide variation in temperature and THI as evident from present findings indicated that lambs were under stress during various months of both seasons of study period. In present study during pre-weaning phase, there were comfortable environmental conditions during months of February and March of season 2 as compared to months of September and October of season 1, due to lower THI. In autumn winter season, lambs were under extreme severe heat stress in months of September and October, which resulted in less average daily gain than lambs of spring summer season. Further, this is also in accordance with Nienaber and Hahn, 2007; Svotwa *et al.,* 2007; Nwosu and Ogbu, 2011 reported that ambient temperature, humidity, wind speed, thermal radiation and precipitation are the major climate parameters which constitute the thermal environment and which are the potential environmental stressors for livestock's with regards to health, growth, yield and reproduction. When these stressors are coupled with other adverse environmental factors (*e.g.* poor nutrition), the animal is at greater risk (Hatfield, 2009). Marai *et al* .(1995,1997, 2000), Shelton (2000), Abdel-hafez (2002) and Marai *et al.*(2007). In post weaning stage, higher ADG were observed in spring summer season as compared to lambs born in autumn winter season, though environmental conditions were not favorable during both seasons either due to cold or heat stress. It could be possibly due to lack of good quality pastures in autumn winter season in months of December to February in comparison to months of June to August, when there was availability of good quality pasture due to adequate rainfall. This is well supported by Ban Salem and Smith, (2008) who stated that due to lack of adequate year round feed resources is important factor contributing to low production in arid and semi arid regions. Results are also in accordance with Albial *et al.* (2014) who reported that pre and post-weaning gain is low when there is poor feed intake accompanied by physiological stress.

CONCLUSION

In arid and semi arid regions of our country, growth of lambs is affected adversely by seasonal or thermal fluctuations as well as by nutritional challenges. So for proper growth of lambs, season should be taken into consideration and body weight of lambs can be improved by the use of appropriate managemental and nutritional strategies *i.e.* improved shelter and improved nutrition.

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