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Effect of supplementary concentrate feeding to lambs on the growth performance and body morphometry

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ABSTRACT

A study was conducted to evaluate the effect of feeding concentrate to suckling lambs on their performance. Experiment comprised 40 day old suckling lambs having 1.56 kg average birth weight, with 20 female and 20 male lambs selected randomly from the flocks of four farmers in village Mundida, Odisha. The male and female lambs were divided into two experimental groups so that each experimental group of 20 lambs consisted of 10 male and equal numbers of females. Group 1 (Control) was maintained on suckling and grazing only, while Group 2, balanced concentrate mixture was supplemented in addition to suckling and grazing. Concentrate was supplemented from 2nd fortnight upto 6th fortnight of age. Body weight, average daily gain were recorded upto14th fortnight of age. Body measurements were recorded at every fortnight interval. Either of the male or female lambs group body weight did not differ significantly till the 2nd fortnight, while upon concentrate supplementation from 2nd fortnight, the lambs in Group 2 showed significantly higher body weights and average daily gain from 3rd fortnight till the end of observation at every stage (14th fortnight). Body measurements differences between the groups were observed only after commencement of the concentrate supplementation which resulted in higher values for the lambs in Group 2 from 4th or 5th till the last fortnight. Results revealed that supplementation of concentrate to the four weeks old grazing lambs for a period of 8 weeks improved the body weight, weight gain and reduces cost of lamb production.

Keywords: Body weight, Body morphometry, Concentrate, Economics, Lamb

Sheep rearing is one of the oldest and most important agricultural enterprises wherein sheep are traditionally raised on stubble, pasture and agricultural by-products. They can survive on extremely poor and low-set vegetation because of their close grazing habit. With this peculiar habit of grazing, sheep can reach to the remotest areas and utilize the vegetation on the lands, which are otherwise uncultivable. India ranks third in sheep population in the world. According to the 20th Livestock Census 2019, sheep population of India was 74.26 million. The total animal meat produced in India during 2020-21 was 8.80 million tonnes, of which the share of sheep meat was about 10.04% (BAHS 2021).While for Odisha, the total animal meat produced during the same period was 213 thousand tonnes, of which the contribution of sheep meat was 17.45 thousand tonnes.

The growth rate and body weight gain in the local sheep is not at par with the national standard as they are reared solely on grazing and day-by-day, the grazing is decreasing. Concentrate supplementation of grazing animals may have various aims, such as to maintain animal performance when herbage availability or quality are low or to improve performance levels further when animals graze *ad lib*. high quality pastures. Provision of concentrate may also reduce risks due to parasitism (Prache 2006). Limited concentrate supplementation in addition to free grazing on community range land substantially improved digestibility of nutrients and overall productivity of sheep (Chaturvedi *et al.* 2001, Santra *et al*. 2002, Chaturvedi *et al*. 2003, Abebe *et al.* 2004, Njoya *et al.* 2005, Charturvedi *et al*. 2006) and growth performance of lambs (Santra *et al.* 2002). With this overview, present study was designed to evaluated the effect of a concentrate supplementation to suckling lambs on their fortnightly body weight, average daily gain and body measurement and economics.

MATERIALS AND METHODS

The experiment was conducted for a period of 7 months on suckling lambs present with farmers of Mundida village in Tirtol block of Jagatsinghpur district which is located in eastern part of Odisha. The experimental animals comprised 40 day old suckling lambs having average birth weight of 1.56 kg with 20 female and 20 male lambs selected randomly from the flocks of four farmers in village Mundida. The male and female lambs were divided into two experimental groups so that each experimental group of 20 lambs consisted of 10 male and equal numbers of

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Table 1. Ingredient and nutrient composition (%) of the concentrate mixture

Ingredient	Per cent
Crushed maize	42
Soybean cake	11
Sesame oil cake	10
Deoiled rice bran	34
Mineral mixture	02
Common salt	01
Nutrient composition (%)	
Dry matter	92.74
Crude protein	18.21
Ash	6.37
Ether extract	5.28
Crude fibre	6.16
NFE*	56.72
ME, MJ/kg DM#	12.74

*Calculated. #Calculated from table values of energy content of the components.

females. G 1 (control) - suckling and grazing only, G2 - control + concentrate mixture @ 50-150 g/head depending on the age. Ingredient and nutrient composition (%) of the concentrate mixture is given in Table 1. Supplementation of concentrate commenced at the end of 2nd fortnight after birth and continued upto 6th fortnight of age. Thus, concentrate supplementation was made for a period of 4 fortnights. Concentrate supplementation was made @ 50 g per head per day for the first fortnight, increased to 100 g and 150 g per head per day for the 2nd and 3rd fortnight respectively, followed by 100 g per head per day for one week and 50 g per head per day in the last week. Finally feeding was stopped at the end of 6th fortnight. Concentrate supplementation was done individually in separate containers in the morning hours before animals were taken out for grazing. The lambs were dewormed at the end of the first fortnight and subsequently at monthly intervals with piperazinehexahydrate @ 200 µg/kg body weight.

Lamb body weight: Individual body weight of the lambs in each group was recorded at an intervals of 14 days from birth to 14th fortnight of age. Body weight was measured with the help of a spring balance of 25 kg capacity (0.1 kg least count) for older lambs. The experimental animals were weighed in the morning before offering feed and water.

Average daily gain (ADG) in weight of lambs:

Average daily gain in weight was calculated at fortnight intervals by the formula,

$$\textit{Average daily gain (ADG, g)} = \frac{w_2 - w_1}{t_2 - t_1} \times 1000$$

where, w_1 is Weight of lamb at birth (kg); w_2 is Weight at the successive fortnight intervals (kg); t_1 is Age of lamb at birth i.e. 0 day; t_2 is Age of the lamb at successive fortnightly intervals.

Body measurements of lambs: Bbiometric / body measurements of lambs were recorded with a standard measuring tape of 3 m with accuracy of 1 mm after the animal was allowed to stand squarely on an even ground with its head a little high (erect) at every fortnight. Parameters recorded were straight body length (Linear distance between the pin bone and point of withers); oblique body length (Linear distance between the pin bone and point of shoulder); height at withers (Measured from the base of the hoof to the point of wither); height at croup (Distance between the base of the hoof to the point of croup); chest girth (Circumference of the chest immediately behind the point of elbow passing over the withers); paunch girth (Circumference around the flank touching the navel point ventrally and touching the posterior border of last rib on both sides).

Statistical analysis: The data from the experiment were subjected to statistical analysis as per the methods suggested by Snedecor and Cochran (1994).

RESULTS AND DISCUSSION

Body weight and average daily gain: The mean fortnightly body weights and average daily gain of male and female lambs are presented in Table 2 and 3. For either the male or female lambs, the birth weight did not differ significantly (P>0.05) and also there was no significant difference up to 2nd fortnight of age. After that, the lambs in Group 2 registered higher (P≤0.05 or 0.01) body weights than those in Group 1 at every stage. The body weight of male lambs in Group 2 was highly significant (P<0.01) from 3rd fortnight of age to 14th fortnight of age. The differences in body weight of female lambs between the groups were found significant (P<0.05) for 3rd fortnight, while from 4th to the end of observation, it highly significant (P<0.01).

The average daily gains between the males or females in the two groups did not differ significantly (P≥0.05), while from 3rd fortnight till the end of observation (14th fortnight), the male lambs in Group 2 registered significantly (P≤0.01) higher daily gains at every stage. However, the differences were found significant (P≤0.05) at 3rd fortnight and highly significant (P≤0.01) from 4th fortnight onwards, at every stage in female lambs. A higher finishing body weight and average daily gain for the lambs in Group 2 which is due to intake of concentrate.

A positive relationship between live weight gain and dietary concentrate intakes have been reported by many workers (Nachtomi *et al*. 1991, Murphy *et al.* 1994, Santra and Pathak 1999). Required quantities of concentrate intake increased availability of readily available carbohydrates, which improved animals' performance and growth (Lee *et al*. 2008) because of increased efficiency of nitrogen and protein in ruminants (Arroquy *et al*. 2004). It is established that supplementation in the form of concentrate mixture improves nutrient digestibility of the total diet (McDonald *et al.* 1988). Kumar *et al*. (2018) observed that supplementation of concentrate feed to sheep significantly (p<0.05) improved birth weight and ADG of lambs in group (G3) fed with concentrate @ 20% compared

Table 2. Fortnightly body weight of lambs

Fortnightly body weight (kg)			
Male		Female	
Group 1	Group 2	Group 1	Group 2
1.72±0.084	1.52±0.064	1.49±0.064	1.52±0.055
2.51±0.11	2.34±0.08	2.1±0.06	2.14±0.06
3.46±0.14	3.37±0.14	2.89±0.09	2.93±0.08
4.68±0.15^{A}	5.26±0.14^{B}	3.94±0.11^{a}	4.43±0.16^{b}
5.66±0.16^{A}	7.23±0.14^{B}	4.86±0.12^{A}	6.16±0.18^{B}
6.53±0.18^{A}	9.0±0.16^{B}	5.67±0.12^{A}	7.63±0.19^{B}
7.38±0.24^{A}	10.59±0.18^{B}	6.30±0.14^{A}	8.94±0.18^{B}
7.98±0.26^{A}	11.57±0.19^{B}	6.89±0.15^{A}	9.71±0.20^{B}
8.39±0.29^{A}	12.27±0.21^{B}	7.26±0.17^{A}	10.27±0.22^{B}
8.88±0.32^{A}	12.79±0.23^{B}	7.65±0.19^{A}	10.75±0.25^{B}
9.38±0.31^{A}	13.2±0.25^{B}	8.12±0.21^{A}	11.23±0.27^{B}
9.76±0.31^{A}	13.6±0.25^{B}	8.44±0.23^{A}	11.63±0.28^{B}
10.25±0.34^{A}	14±0.25^{B}	8.83±0.23^{A}	12.06±0.28^{B}
10.77±0.32^{A}	14.43±0.26^{B}	9.29±0.22^{A}	12.53±0.29^{B}
11.39±0.30^{A}	14.98±0.26^{B}	9.8±0.74^{A}	13.05±0.89^{B}

^{a,b}Means in a row bearing different superscripts differ significantly (P<0.05). ^{A,B}Means in a row bearing different superscripts differ significantly (P<0.01).

Table 3. Average daily gain in weight of lambs

Average daily gain (g/day)			
Male		Female	
Group 1	Group 2	Group 1	Group 2
56.43±3.76	58.57±2.78	43.57±2.25	44.28±2.56
62.14±3.54	66.07±2.83	50.00±2.66	50.36±2.79
70.48±2.80^{A}	89.05±2.16^{B}	58.33±2.30^{a}	69.28±3.91^{b}
70.36±2.51^{A}	101.96±1.85^{B}	60.18±1.99^{A}	82.86±3.13^{B}
68.71±2.31^{A}	106.86±1.69^{B}	59.71±1.70^{A}	87.28±2.60^{B}
67.38±2.36^{A}	107.98±1.65 ^{B}	56.21±1.68^{A}	88.33±2.10^{B}
63.88±2.32^{A}	102.55±1.61^{B}	55.10±1.55^{A}	83.57±1.97^{B}
59.55±2.41^{A}	95.98±1.59^{B}	51.52±1.48^{A}	78.12±1.96^{B}
56.82±2.43^{A}	89.44±1.56^{B}	48.89±1.53^{A}	73.25±1.91^{B}
54.71±2.12^{A}	83.43±1.52^{B}	47.36±1.53^{A}	69.36±1.86^{B}
52.21±1.90^{A}	78.44±1.33^{B}	45.13±1.48^{A}	65.65±1.78^{B}
50.77±1.87^{A}	74.28±1.21^{B}	43.69±1.37^{A}	62.74±1.66^{B}
49.72±1.64^{A}	70.93±1.18^{B}	42.86±1.22^{A}	60.49±1.55^{B}
49.34±1.43^{A}	68.67±1.12^{B}	42.40±1.21^{A}	58.83±1.39^{B}

^{a,b}Means in a row bearing different superscripts differ significantly (P<0.05). ^{A,B}Means in a row bearing different superscripts differ significantly (P<0.01).

to concentrate feed supplementation @ 10% of dry matter requirement (G2) or non supplemented groups (G1). Jin and Zhou (2022) studied 60 male Tan lambs (21±1.23 kg body weight) fed with a finishing diet (concentrate to forage ratio: 35:65 [LC group] or 55:45 [HC group]) with daily Cr-Met supplementation (0, 0.75, or 1.50 g) and observed that lambs from the HC group had higher average daily gain.

A supplementation of 250 g concentrate in addition to grazing has been recommended to raise sheep under extensive production system in semi-arid regions of India (Karim *et al*. 2004). Experimental results indicated that limited amount of concentrate supplementation in addition to free grazing on rangeland would improve daily body weight gain as well as finishing body weight of lambs (Patnayak *et al*. 1995, Shinde *et al*. 1995, Karim 1999, Chaturvedi *et al*. 2000, Santra *et al*. 2002). Tripathi *et al*. (2007) also reported improvement in growth and feed efficiency with increasing amounts of concentrate in the lambs' diet. Chaturvedi *et al.* (2010) reported that 2-3 month old lambs receiving concentrate mixture @ 1.5% of body weight for 90 days had higher (P<0.05) finishing weight, total gain and average daily gain (P≤0.01).This was attributed to greater (P<0.01) digestibility of dry matter, organic matter, crude protein, neutral detergent fibre and acid detergent fibre in the supplemented group.

Besides, the timing of commencement of the concentrate supplementation would have played a vital role, because the supplementation was made at a stage when ewes were supposed to be in their declining phase of lactation, thereby causing reduced milk availability for the growing lambs. Cardellino and Benson (2002) reported that ewes reached their peak milk yield at 21-30 days of lactation, while Kassab *et al*. (2009) observed maximum milk yield at 2nd week of lactation. Tripathi *et al*. (2011) also observed that during the first week of life, lambs' growth and development was influenced by ewe's milk yield. Lambs on inadequate milk during the first month of life were more prone to infectious diseases and show overall poor growth. The lambs started nibbling on feeds within a few days of birth and consumed very little in terms of dry matter. Although feed intake was minimal during early age, it was important to introduce creep feed to the lambs at 10 days of age. Malisetty and Yerradoddi (2013) revealed that, the final body weight, total weight gain and average daily gain were significantly (P<0.01) higher in concentrate supplemented ram lambs in comparison to solely grazed animals. Lavania and Kumar (2016) found that concentrate supplemented group of lambs along with grazing achieved significantly higher (P<0.01) average daily gain (g) than the only grazing group. Liu *et al*. (2019) showed that increasing dietary concentrate feed level from 0% to 60% exerted a positive effect on DMI, BW gain, gain rate and feed conversation ratio (FCR) in Tibetan sheep.

Body morphometry: The body measurements viz. straight length, oblique length, and height of withers; croup height, chest girth and punch girth of Group 1 and Group 2 lambs, sex wise, from birth to 14th fortnight of age are presented in Supplementary Tables 1-6. For either the males or females, all the body measurement parameters remained similar between the groups until 3rd or 4th fortnight. Differences between the groups were observed only after commencement of the concentrate supplementation which resulted in higher values for the lambs in Group 2 from 4th or 5th till the last fortnight. Hence, the higher values in favour of lambs in Group 2 may be attributed to the concentrate

Table 4. Economics of lamb production

Particular	Group 1	Group 2
Initial body weight (₹)	1.60	1.52
Final body weight (kg)	10.60	14.02
Total weight gain (kg) (2-1)	9.00	12.50
Cost per kg concentrate (₹)	0	15
Total concentrate fed (kg)	0	5.25
Cost of concentrate (₹)	0	79
Cost of extra live weight gain (₹) @ ₹100/kg live weight	-	350
Net profit (₹) per lamb (7-6)	-	270

supplementation. Besides, the supplementation in the present experiment was made at a stage when the ewes were in their declining phase of lactation, thereby causing a reduced availability of milk for lambs. Cardellino and Benson (2002) reported that ewes reached their maximum milk yield at 21-30 days of lactation, while Kassab *et al*. (2009) observed maximum milk yield at the second week of lactation. Chaturvedi *et al.* (2010) reported that the body conformation parameters, viz. height, length, heart girth and paunch girth being almost similar in both the groups at weaning (3months) initially, were higher in concentrate supplemented as compared to unsupplemented group at 6 month of age. Difference might be due to feeding of concentrate.

Incidence of diseases and mortality: No mortality due to disease was observed during the period of experiment in the experimental animals.

Economics of production: The statement of cost and returns per animal is given in Table 4. Since the farmers were providing their own labour in management and grazing of lambs, the cost of only concentrate mixture was considered as the additional cost. The total feed supplemented in Group 2 was 5.25 kg per lamb, the cost of which was calculated to be ₹ 79.0 @ ₹ 15 per kg. The additional income was observed to be higher in Group 2 than that of Group 1. In the present experiment, net return per animal was ₹ 240.0 higher in Group 2 than Group 1 which implied for better cost effective mutton production. Similar findings were also reported by Chaturvedi *et al*. (2010). They reported that concentrate supplementation @ 1.5% of the body weight to the lambs during this active phase of growth enhanced their growth rate for cost effective mutton production. Solanki *et al*. (2009) calculated the economics of local goats in semi-intensive and extensive system of management. He reported that net return per animal was ₹ 253.80 in semi-intensive system and ₹ 195.35 in the extensive system respectively. Malisetty and Yerradoddi (2013) reported that the cost per kg gains was less in concentrate supplemented animals than solely grazed. Net profit available per ewe was more in group fed with concentrate @ 20% followed by concentrate feed supplementation @ 10% and non-supplemented groups as recorded by (Kumar *et al.* 2018). Lavania, and Kumar (2016) also concluded that supplementary feeding of concentrate with grazing was beneficial in growing sheep for higher economic returns.

From the present study, it may be concluded that supplementation of concentrate to the four weeks old grazing lambs for a period of 8 weeks improved the body weight, weight gain. It also resulted in reduction in cost of lamb production

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