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Impact of dairy based starter rations on growth performance, feed efficiency and profitability in raising Malabari goat kids

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Abstract
An experiment was conducted to study the impact of skimmed milk powder and dried whey in starter ration on growth, feed efficiency and profitability of pre-weaned Malabari goat kids. Fourteen days old Malabari kids (n=18) were selected and assigned randomly to three treatment groups (T1, T2, T3). Milk was offered upto 90 days of age for T1 and upto 45 days of age for both T2 and T3. Kid starter and green fodder was offered for all the kids. Kids in T1 were fed with conventional starter ration whereas, dairy based starter rations containing dried whey powder and skimmed milk powder (SMP) were offered for kids in T2 (15% whey & 5% SMP) and T3 (10% whey & 10% SMP). The experiment was conducted for a period of four months. Fortnightly body weight and body condition score were recorded. Daily feed intake was recorded. Statistical analysis of data revealed that body weight, average daily gain and body condition score of kids were similar (P>0.05) among groups. The feed conversion ratio of experimental kids was similar (P>0.05) in T1, T2 and T3 groups and the respective values were 3.14±0.14, 3.02±0.24 and 3.27±0.25. The cost per kg gain for groups T2 and T3 was similar, but was significantly lower (P<0.01) than the T1 group. Hence, it can be concluded that inclusion of SMP and dried whey in starter ration of early weaned Malabari kids can promote optimum growth and reduce the overall cost of production compared to rearing kids on conventional starter rations.

Keywords: Goat kids, starter, skimmed milk powder, whey, weaning, growth, economics, feed efficiency, body condition score

1. Introduction
Dairy goat husbandry in India plays a crucial role in global agriculture, contributing approximately 33% of the world's goat milk production (DAHD, 2023) [2]. This sector not only provides milk but also meat and various value-added products, making it an essential agricultural enterprise. The increasing awareness of the nutritional and therapeutic benefits of goat milk, alongside its export potential, has spurred the growth of commercial dairy goat farming in the country. Goat milk is often considered superior to cow milk due to its higher digestibility and health-promoting properties, which stem from its unique composition of biologically active components such as peptides, oligosaccharides, fatty acids, and phospholipids. Additionally, goats are well-suited for small-scale farming because of their adaptability to diverse environments, low feed requirements, and high reproductive rates.
A key strategy for enhancing dairy goat productivity is the practice of early weaning and the introduction of starter rations. Gradual transition of kids from milk to solid feed after two weeks of birth can significantly reduce weaning stress and improve growth performance. Early exposure to starter rations promotes rumen development, which is vital for effective nutrient absorption. Incorporating high-quality dairy ingredients such as skimmed milk powder (SMP) and dried whey in starter rations can further enhance growth, as these ingredients are rich in protein, lactose, and essential nutrients, closely resembling the composition of doe's milk. Despite the promising benefits, there is a notable lack of comprehensive research in this area, underscoring the need for further studies to evaluate the impact of dairy-based starter rations on the growth performance of kids and to enhance the overall productivity and profitability of

dairy goat farming in India.

In view of the above facts, this study was proposed to evaluate impact of incorporation of skimmed milk powder and whey in starter ration on growth performance, feed efficiency and economics of rearing pre-weaned Malabari goat kids.

2. Materials and Methods

Eighteen Malabari kids of 14 days old, with an average body weight of 2.60 ± 0.52 kg, were selected and kept in individual pens within a well-ventilated shed. They were raised under an intensive management system for a period of four months. The ear tags were applied to all experimental kids to facilitate precise identification and data collection. Prior to the commencement of the experiment, all the kids were dewormed with Fenbendazole at a dosage of 7.50 mg per kg of body weight and was subsequently repeated at monthly intervals as a prophylactic measure.

The experimental kids were randomly assigned to three treatment groups (T1, T2 & T3). The T1 group was offered with milk up to 90 days of age and for T2 and T3 groups, milk was fed only up to 45 days of age. All the experimental kids were provided with starter ration (CP-23%; TDN-70%) and hybrid Napier fodder from 14 days of age. The kids in T1 group were fed with conventional starter while dairy based starter rations were offered for T2 (5% SMP and 15% dried whey) and T3 (10% SMP and 10% dried whey). The feeding was done for a period of four months as per the feeding standards (ICAR, 2013) [5].

The kids were weighed initially and thereafter at fortnightly intervals in the morning before feeding. The daily feed intake of kids was recorded. The body condition score of experimental kids was recorded at fortnightly intervals and was done based on 1 to 5 scale system with an interval range of 0.5 point as per the procedures suggested by Jefferies (1961) [6]. Cost of feeding under different dietary treatments were calculated from the records of daily feed consumption and by considering the procurement cost of milk, feed and fodder used for feeding experimental kids. Statistical analysis of data obtained in the study was done by using SPSS version 20.0.

3. Results and Discussion

3.1 Growth performance

The body weight and average daily gain of experimental kids maintained on three treatments (T1, T2, and T3) at fortnightly intervals are displayed graphically in Fig. 1 and 2, respectively. The mean body weight (kg) of the kids at start of the trial was 2.46±0.12, 2.75±0.21, 2.47±0.24 in T1, T2, T3 groups, respectively. The final body weight of experimental kids was 6.94±0.45 in T1, 7.49±0.41 in T2 and 7.03±0.42 in T3. The kids in different dietary regimes showed similar (P>0.05) body weight throughout the study (Fig. 1). The overall average daily gain (ADG) of experimental kids (g) in T1, T2 and T3 was 42.7±3.40, 45.16±3.04 and 43.41±4.26, respectively (Table 01) and was found to be similar (P>0.05) among groups. Cessation of milk feeding to kids at 45 days had no adverse effects on growth characteristics, emphasizing nutritional adequacy of dairy based starter rations and physiological adaptability of kids to those rations.

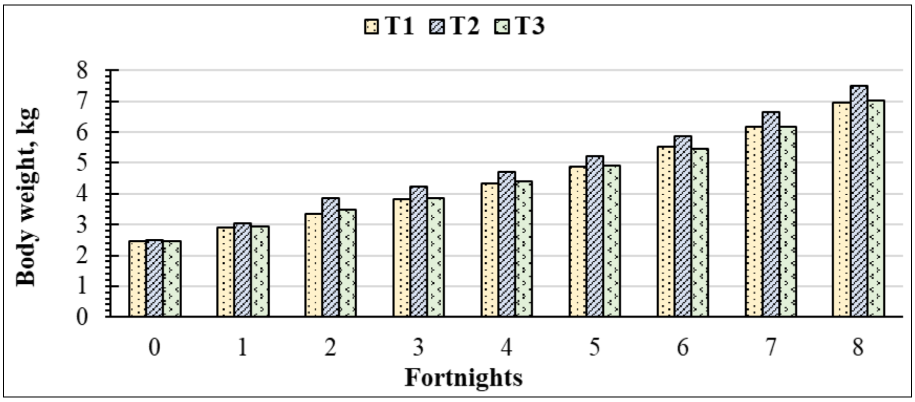

Fig. 1: Fortnightly average body weight of experimental kids maintained on three dietary treatments, kg

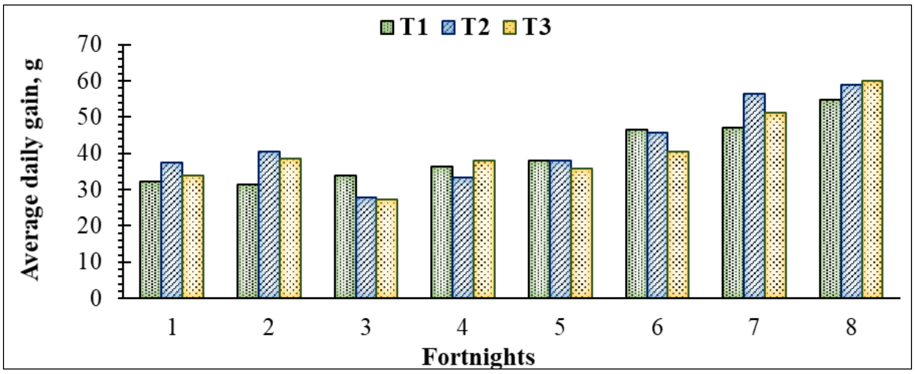

Fig. 2: Fortnightly average daily gain of experimental kids maintained on three dietary treatments, g

The results of the present study were in accordance with the findings of various studies (Nishiyama *et al.*, 2011; Yasumatsuya *et al.*, 2012; Huuskonen, 2017) [10, 16, 4]. Whey contains high lactose (75% of dry matter) and is rich in minerals and vitamins (Ozdemir *et al.*, 2020) [11] which is a potential source for kid's growth and it was observed earlier in Sannen kids that the body weight were unaffected (P>0.05) by incorporating whey at different levels (5 and 10 per cent).

Terosky *et al.* (1997) [14] revealed that diets with varied ratio of dried skim milk to whey protein concentrates had no effects on growth in Holstein calves reared up to 8 weeks of age. The present findings were also in agreement with the results of Benak *et al.* (2021) [1] in which the body weight was found to be similar (P>0.05) between calves fed with conventional starter ration and ration containing 7 per cent whey. On the contrary, Kamalahasan (2018) [7] observed that the body weight and ADG was higher (P<0.05) in whole milk fed calves than those fed with whey based milk replacer. Sasikala (2018) [13] also reported that the kids offered goat milk had higher body weight than those fed with milk replacer containing SMP and dried whey.

Table 1: Data[1] on body weight, total body weight gain and average daily gain[1] of experimental kids maintained on three dietary treatments

Parameters	Dietary Treatments			P value
	T1	T2	T3	
Initial body weight, kg	2.46±0.12	2.75±0.21	2.47±0.24	0.509 ns
Final body weight, kg	6.94±0.45	7.49±0.41	7.03±0.42	0.630 ns
Total weight gain, kg	4.48±0.36	4.74±0.32	4.56±0.45	0.885 ns
Mean daily gain, g	42.70±3.40	45.16±3.04	43.41±4.26	0.885 ns

[1]Mean values based on six replicates with SE; ns-non significant (P>0.05)

3.2 Feed efficiency

Total dry matter intake (DMI) in three experimental groups (kg/animal) was 14.05±1.21 in T1, 14.02±0.55 in T2 and 14.37±0.33 in T3 groups. The DMI of kids was similar (P>0.05) among groups. The mean cumulative feed conversion ratio reported for experimental kids in groups T1, T2 and T3, respectively, was 3.14±0.14, 3.02±0.24 and 3.27±0.25, as stated in Table 02. Hasanpour *et al.* (2023) [3] also reported similar FCR among lambs fed with total mixed ration containing varying inclusions levels of dried whey. However, Lee *et al.* (2009) [8] found a higher (P<0.05) gain to feed ratio in Holstein calves fed whole milk compared to those offered dairy based milk replacer. This discrepancy might be due to the fact that even though dried whey and SMP can effectively provide energy and protein, it may not fully meet their optimal growth needs of calves compared to more balanced diets, such as dams' milk. Nevertheless, the results of the present study suggests that dairy based starter ration can still support reasonable feed efficiency in kids.

Table 2: Data[1] on feed intake and feed conversion ratio of experimental kids maintained on three dietary treatments

Parameters	Dietary Treatments			P value
	T1	T2	T3	
Total feed intake*, (kg/animal)	14.05±1.21	14.02±0.55	14.37±0.33	0.943ns
Total weight gain, kg	4.48±0.36	4.74±0.32	4.56±0.45	0.885ns
Feed conversion ratio (kg feed/kg body wt. gain)	3.14±0.14	3.02±0.27	3.27±0.25	0.896ns

[1]Mean values based on six replicates with SE; ns-non significant (P>0.05)
*Values presented on dry matter basis

3.3. Body condition score

Integrating body condition score (BCS) with nutritional and management strategies is crucial for optimizing flock production, as BCS serves as an indicator of the health and welfare status of animals. In the present study, the fortnightly average BCS of experimental kids fed diets with varying levels of SMP and dried whey is presented in Table 3. The statistical analysis revealed no significant differences in BCS among the three experimental groups, indicating consistent growth status across the treatments. These findings align with previous studies (Ozdemir *et al*., 2020; Manav and Yilmaz, 2021; Salehi *et al*., 2022) [11,9,12], which also emphasized similar BCS among kids fed with dairy based rations.

Table 3: Fortnightly body condition score[1] of experimental kids maintained on three dietary treatments

Fortnights	Dietary Treatments			P value
	T1	T2	T3	
Initial (at 14 days of age)	1.67±0.11	1.75±0.11	1.75±0.11	0.809 ns
1	1.67±0.11	1.75±0.11	1.83±0.11	0.530 ns
2	1.67±0.11	1.83±0.11	1.83±0.11	0.470 ns
3	1.83±0.11	2.00±0.18	1.92±0.08	0.716 ns
4	1.92±0.15	2.17±0.17	1.92±0.08	0.346 ns
5	2.17±0.11	2.17±0.17	2.08±0.15	0.887 ns
6	2.17±0.11	2.42±0.15	2.17±0.17	0.427 ns
7	2.25±0.11	2.67±0.17	2.33±0.17	0.125 ns
8	2.25±0.11	2.67±0.17	2.33±0.21	0.188 ns

[1]Mean values based on six replicates with SE; ns-non significant (P>0.05)

3.4. Techno-economics of production

The techno-economics of production of experimental kids maintained on three different rations obtained in the current study is given in Table 4. The feed cost (Rs.) per kg gain of experimental kids belonging to treatment groups T1, T2 and T3 were 730.47±39.06, 465.99±38.52 and 502.68±52.40, respectively. The cost per kg gain for groups T2 and T3 was similar but was significantly lower (P<0.01) than for the T1 group. Milk feeding resulted in a higher cost per kg gain compared to rearing kids on dairy-based milk replacers and the observation was in consonance with the findings of Kamalahasan (2018) [7] and Sasikala (2018) [13]. Furthermore, Torres *et al.* (2021) demonstrated that total cost per Canarian goat kids was lower in early weaned group (6 weeks) than in kids weaned at 9 weeks of age. This suggests that early weaning along with the use of dairy-based rations can contribute to significant cost savings in goat kids without compromising growth performance and feed efficiency.

Table 4: Economics of production[1] of experimental kids maintained on three dietary treatments

Parameters	Dietary Treatments			P value
	T1	T2	T3	
Total milk consumed (kg/kid) (DM basis)	$31.91^a\pm1.66$	$15.01^b\pm1.15$	$13.00^b\pm1.03$	0.000***
Cost of milk (Rs. /kg)	90	90	90	
Total Cost of milk (Rs. /kid)	$2872.28^a\pm149.17$	$1350.86^b\pm103.71$	$1169.91^b\pm92.92$	0.000***
Total kid starter intake, on fresh basis (kg/kid)	$7.47^b\pm1.12$	$9.94^a\pm0.53$	$10.63^a\pm0.40$	0.023*
Cost of kid starter (Rs. /kg)	37	74	88	
Total cost of kid starter (Rs. /kid)	$276.44^c\pm41.46$	$735.63^b\pm39.2$	$935.44^a\pm35.01$	0.000***
Total green fodder intake, on fresh basis (kg/kid)	15.81 ± 0.36	16.02 ± 0.68	15.81 ± 0.54	0.951^{ns}
Cost of green fodder (Rs. /kg)	4.95	4.95	4.95	
Total cost of green fodder (Rs. /kid)	78.27 ± 1.78	79.32 ± 3.35	78.28 ± 2.66	0.950^{ns}
Total feeding cost (Rs. /kid)	$3226.98^a\pm187.19$	$2165.80^b\pm131.85$	$2183.63^b\pm73.45$	0.000***
Total weight gain (kg/kid)	4.48 ± 0.36	4.74 ± 0.32	4.56 ± 0.45	0.885^{ns}
Feed cost per kg body weight gain (Rs. /kg)	$730.47^a\pm39.06$	$465.99^b\pm38.52$	$502.68^b\pm52.40$	0.001**

[1]Mean values based on six replicates with SE; ns-non significant ($P>0.05$)

[a-c]Mean of different treatment having different superscripts within a row differ significantly (***- $P<0.001$; **- $P<0.01$; * - $P<0.05$)

4. Conclusion

Critical appraisal of the results obtained in the current study indicates that early weaning (at 45 days of age) and raising Malabari kids on starter rations containing dairy based ingredients resulted in comparable growth performance to that of kids fed milk upto 90 days of age along with conventional starter ration. Moreover, the cost per kg gain was lower in groups offered dairy based starter rations after cessation of milk feeding at an earlier age. Hence it can be concluded that inclusion of SMP and dried whey in starter ration of early weaned Malabari kids can promote optimum growth and reduce the overall cost of production compared to rearing kids on conventional starter rations.

Conflict of Interest

Not available

Financial Support

Not available

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