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Biometrics of Malabari goat kids raised on dairy based starter rations

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Abstract
An experiment was conducted to evaluate the effect of feeding dairy based starter rations on body biometrics of Malabari goat kids. Eighteen Malabari kids of fourteen days old were selected and randomly assigned to three treatment groups (T_1, T_2, T_3). Milk was offered upto 90 days of age for T_1 and upto 45 days of age for both T_2 and T_3. Kid starter and green fodder was offered for all the kids. Kids in T_1 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 T_2 (15% whey & 5% SMP) and T_3 (10% whey & 10% SMP). The experimental kids were reared upto 120 days of age. Body biometrics of kids *viz.* height at withers, body length, heart girth, hip width, face length and tail length were recorded at fortnightly intervals. At 120 days of age, the mean value (cm) of wither height was 47.33, 48.83 and 48.08, body length was 45.17, 45.83 and 45.83, heart girth was 43.50, 45.00 and 44.83, hip width was 44.33, 45.83 and 45.92, face length was 15.17, 15.58 and 15.83 and tail length was 13.92, 13.67 and 14.17 in T_1, T_2 and T_3 groups, respectively. The results revealed similar (p>0.05) body measurements in Malabari kids offered with different starter rations. Hence, it can be concluded that the stopping milk feeding at an early age (45 days of age) by providing dairy based starter rations has no adverse effects on body biometrics and may improve the farm economy as it spares dams milk for human consumption.

Keywords: Goat kids, starter, skimmed milk powder, whey, early weaning, biometrics

Introduction
Goats make a substantial economic contribution to the country and contribute significantly to the nutritional security of rural livelihoods, by offering animal protein sources such as meat and milk. India is the largest milk producer in the world with annual (2022-23) milk production of 230.58 million tonnes of which, goat milk shares a contribution of 3.30% (DAHD. 2023.) [2]. Goat milk is better than cow's milk and more similar to human milk with higher digestibility, less allergenicity, high proportion of short-chain fatty acids, and smaller fat globules (Pal, 2014) [16]. It also serves as a medicinal food for persons suffering with milk allergies, and other diseases such as asthma, insomnia, migraine, eczema, neurotic indigestion, acidity, stomach ulcer, colitis, constipation, gall bladder stones and liver disorders (Yangilar, 2013; Pal, 2014) [21, 16]. Thus, Goat milk's strong therapeutic significance for human health has led to global growth in its economic value. Besides, it also has higher demand in dairy products manufacturing sector.

Under extensive production systems, kids are reared along with the nursing dam for 60-75 days after birth and the does are not milked during this period. However, housing the kids together with their dams during this period decreases the income from milk sales (Guney *et al.*, 1995; Keskin, 2002) [4, 7]. Different kid rearing systems can be adopted to provide maximum marketable milk yield during the suckling period to increase farm profitability. Early introduction of starter ration by stopping milk feeding is one of these methods; however, the digestive limitations of pre-ruminant kid is crucial in such situations. Digestive tracts of kids are equipped for efficiently digesting milk as a primary source of energy (Meale *et al.*, 2017) [12]. Thus, ingredient selection and formulation of starter ration is critical to allow adequate digestion and nutrient bio-availability for proper growth and performance of kids. Therefore, it is predicted that feeding a dairy-based starter, (Terre *et al.*, 2016) [18], can increase the

acceptability and digestibility of feed, and ensures adequate consumption to meet the nutrient requirements of early life. Novel dairy based starter feeds which are more palatable and acceptable at the same time digestible need to be formulated and studied.

Moreover, considering the health benefits of goat milk, it will be beneficial to the society, if more quantity is made available for human consumption. This can be achieved by stopping milk feeding to kids at an early age and rearing them on high quality starter rations without compromising their health and growth characteristics. In view of this, present study was conducted to evaluate the biometrics of early weaned kids during the growth period, offered with starter rations incorporated with dairy based ingredients such as skimmed milk powder (SMP) and dried whey powder.

Materials and Methods

Eighteen pre-weaned Malabari goat kids of 14 days age with uniform body weight (2.60 ± 0.52 kg) were selected and housed individually in well- ventilated shed and reared under intensive system up to four months of age at University sheep and goat farm, Mannuthy. The experimental kids were ear tagged for proper identification and recording of data. All the kids were dewormed with Fenbendazole (7.50 mg / kg body weight) before the start of the experiment and deworming was repeated periodically at monthly interval.

The kids were randomly allotted to three experimental groups (T_1, T_2 & T_3) and kids in T_1 were fed with milk up to three months of age @ 1/6th , 1/8th and 1/10th of their body weight at 1st , 2nd and 3rd month of age respectively. Whereas, for T_2 and T_3, milk was offered only up to 45 days of age @ 1/6th of body weight for 1st month and, 1/8th of body weight later. Kid starter (CP-23%; TDN-70%) and green fodder was introduced in all the experimental groups at 14 days of age and was offered throughout the study as per the ICAR feeding standards (2013) [5]. The kids in T_1 were fed with conventional kid starter while dairy based starter rations containing dried whey and SMP were offered for T_2 (15% dried whey and 5% SMP) and T_3 (10% dried whey and 10% SMP). Ingredient composition of kid starter rations offered to experimental animals is given in Table 1.

Table 1: The ingredient composition of kid starter rations.

Ingredients	T_1	T_2	T_3
Maize	26	16	16
Corn gluten fibre	19	6.5	5.5
Gingelly oilcake	8	8	7
Coconut oilcake	5	5	5
Soybean meal	10	10	9
Alfalfa meal	12	12	11
Wheat bran	14	15.5	16.5
Black gram husk	4	5	8
Dried whey	-	15	10
SMP	-	5	10
Mineral mixture	1.5	1.5	1.5
Salt	0.5	0.5	0.5
Total	100	100	100

Biometric parameters were recorded at fortnightly intervals by using a standard measuring tape to the nearest 0.5 centimetre by allowing the kids to stand squarely on an even ground. This was performed in the morning before the animals were fed. Biometric parameters were recorded as per the approved guidelines (FAO, 2012) [3] of goat breed. Biometric parameters evaluated during the study and the measuring method for each biometric trait is described in the Table 2.

Table 2: Methods of assessing the biometric traits in Malabari kids

Biometric traits	Measuring technique
Height at withers	Vertical distance between the fetlock and the highest point of withers
Heart girth	Body circumference around the heart, just behind the withers on top and elbow joint on the bottom
Body length	Distance between point of shoulder and the point of tuber ischii (pin bone)
Hip width	Distance from the tuberosity prominence of ilium bone of one side to the other, across the rump
Face length	Distance between upper lip and poll of the head
Tail length	Distance from the base of the tail to the tip of tail.

Source: FAO (2012) [3]

Statistical analysis of the data was carried out in accordance with Snedecor and Cochran (1989) [17] using SPSS 29.0.10. computer software.

Results and Discussion

Biometric parameters in Malabari kids

Biometric parameters (height at withers, heart girth, body length, hip width, face length and tail length) of Malabari kids in three different experimental groups is presented in Table 3 to 08. All the body biometrics increased linearly with age.

Height at withers

The mean initial height at withers (cm) of kids were similar among the groups with values 36.33, 37.25 and 36.5 in T_1, T_2 and T_3 respectively (Table 3). Height at withers remained similar among the groups throughout the study and the values observed at 120 days of age, were 47.33 in T_1, 48.83 in T_2 and 48.08 in T_3 groups. The results of the study is in accordance with the findings in Sirohi kids reared after weaning at different ages (Meena *et al.*, 2022) [13]. However, the values observed during the present study in Malabari kids is lower compared to the findings in Berari goat kids (Kharkar *et al.*, 2014) [9] reared up to 3 months of age (49.05 cm). This variation might be due to difference in breed and other management practices.

Table 3: Height at withers (Mean±SE) of kids (cm) fed different starter rations.

Fortnights	T_1	T_2	T_3	*p*-value
1	36.33±0.40	37.25±0.67	36.50±0.99	0.646
2	37.75±0.40	38.58±1.19	37.58±0.91	0.704
3	39.67±0.40	40.00±1.03	39.17±0.74	0.747
4	40.75±0.44	41.33±0.96	40.08±0.76	0.516
5	41.75±0.40	42.33±1.02	41.25±0.91	0.656
6	42.83±0.33	43.75±1.12	42.75±0.95	0.671
7	44.42±0.55	45.17±1.30	44.25±1.15	0.809
8	45.92±0.69	47.00±1.34	46.08±1.20	0.763
9	47.33±0.84	48.83±1.36	48.08±1.20	0.663

Body length

The initial and final mean body length (cm) of Malabari kids in T_1, T_2, T_3 groups were 32.83, 33.33, 31.83 and 45.17, 45.83, 45.83 respectively (Table 4). Mean body length between groups did not vary significantly during the trial period. Similar findings were also observed in Sannen goat kids (Manav and Yilmaz, 2021) [11], fed with milk replacers containing whey powder and propolis. However, Tudu *et al.* (2015) [19] and Jannat *et al*. (2023) [6] observed lesser body

length in Bengal and Jamunapari goats of 3 to 6 months age respectively.

Table 4: Body length (Mean±SE) of kids fed different starter rations.

Fortnights	T_1	T_2	T_3	*p*-value
1	32.83±0.70	33.33±0.71	31.83±0.48	0.273
2	35.67±0.84	36.33±1.15	34.83±0.48	0.488
3	37.25±0.63	38.58±0.76	37.17±0.54	0.255
4	38.92±0.77	39.50±0.99	38.67±0.65	0.764
5	39.75±0.85	40.83±0.99	39.92±0.64	0.626
6	41.67±0.93	41.92±1.00	41.42±0.78	0.927
7	42.75±1.01	43.08±0.95	42.83±1.01	0.970
8	43.92±1.14	44.50±0.96	44.25±0.98	0.923
9	45.17±1.25	45.83±0.98	45.83±1.01	0.883

Heart girth

The mean heart girth (cm) of Malabari kids in T_1, T_2, T_3 groups at the start and end of the experiment were 33.00, 35.00, 33.25 and 43.5, 45.00, 44.83 respectively (Table 5). The results did not vary significantly between kids fed with different starter rations. This is in accordance with the findings of Ozdemir *et al.* (2020) [15] and Benak *et al.* (2021) [1] in which goats offered with whey based rations showed non significant mean heart girth.

Table 5: Heart girth (Mean±SE) of kids fed different starter rations.

Fortnights	T_1	T_2	T_3	*p*-value
1	33.00±0.61	35.00±1.00	33.25±0.66	0.172
2	34.83±0.60	37.00±1.00	35.00±1.10	0.216
3	36.25±0.54	38.50±1.15	36.75±0.96	0.228
4	37.25±0.67	39.33±1.22	38.17±0.90	0.332
5	38.25±0.81	40.25±1.11	39.25±0.73	0.318
6	39.83±0.88	43.17±1.60	40.83±0.59	0.125
7	41.08±0.94	42.75±1.01	42.25±0.70	0.424
8	43.50±1.18	45.00±1.03	44.83±0.87	0.428
9	42.25±1.06	44.00±1.03	43.58±0.77	0.545

Hip width

At the start and the end of the feeding trial, the mean hip width (cm) of the Malabari kids in groups T_1, T_2, and T_3 groups were 29.33, 31.25, 30.83 and 44.33, 45.83, 45.92 respectively. The observed values were similar (p>0.05) among the treatment groups. The results of the present study were in agreement with Moallem *et al.* (2010) [14] where similar (p>0.05) hip width was obtained in the Israeli Holstein calves fed with milk replacer (92% milk protein sources) and whole milk upto 60 days of age. Additionally, the research on Sirohi goat kids (Meena *et al.*, 2022) [13] also revealed similar results , in which hip width at 120 days did not differ significantly among kids weaned at different ages.

Table 6. Hip width (Mean±SE) of kids fed different starter rations.

Fortnights	T_1	T_2	T_3	*p*-value
1	29.33±0.65	31.25±0.98	30.83±1.45	0.437
2	32.00±0.52	33.75±1.50	32.25±1.20	0.522
3	34.42±0.52	36.75±0.96	35.08±0.90	0.150
4	36.33±0.57	38.83±1.35	37.67±1.06	0.270
5	38.42±0.42	40.00±1.37	40.17±1.05	0.430
6	40.08±0.58	41.67±1.21	42.17±0.97	0.304
7	41.83±0.64	43.08±1.13	43.58±0.89	0.396
8	43.25±0.73	44.75±1.00	45.08±0.84	0.306
9	44.33±0.76	45.83±1.01	45.92±0.78	0.366

Face length

The average face length of Malabari kids subjected to different feed regimes (T_1, T_2, T_3) was found to be 12.25, 13.33, 13.08 and 15.17, 15.58, 15.83 in the first and ninth fortnights respectively (Table 7). The mean face length of Malabari kids was similar (p>0.05) in all the groups. However, the observed findings are higher than those reported earlier (Verma *et al.*, 2009) [20], in Malabari kids of three to six months age (11.40 to 12.95). The difference in values might be due to the varied plane of nutrition and other management practices.

Table 7: Face length (Mean±SE) of kids fed different starter rations.

Fortnights	T_1	T_2	T_3	*p*-value
1	12.25±0.44	13.33±0.33	13.08±0.27	0.112
2	12.50±0.39	13.58±0.40	13.50±0.22	0.077
3	12.92±0.44	13.83±0.38	13.67±0.17	0.173
4	13.42±0.44	14.25±0.38	14.00±0.22	0.272
5	13.75±0.50	14.50±0.32	14.42±0.20	0.298
6	14.17±0.46	14.58±0.33	14.58±0.24	0.638
7	14.50±0.50	15.00±0.32	15.08±0.24	0.497
8	14.83±0.51	15.25±0.38	15.50±0.22	0.492
9	15.17±0.54	15.58±0.33	15.83±0.31	0.519

Tail length

At 14 and 120 days of age, the Malabari kids in T_1, T_2 and T_3 were found to have the average tail length (Table 8) of 11, 10.67, 10.67 and 13.92, 13.67, 14.17 respectively. The mean tail length of Katjang goat kids (Khandoker *et al.*, 2017) [8] of less than one year (7.87 to 9.15 cm) and Jaunpuri kids (Kumar *et al.*, 2017) [10] of three to six months age (8.8 cm), which were lower than the results obtained in the present study.

Table 8: Tail length (Mean±SE) of kids fed different starter rations.

Fortnights	T_1	T_2	T_3	*p*-value
1	11.00±0.26	10.67±0.21	10.67±0.33	0.616
2	11.33±0.25	11.17±0.31	11.50±0.34	0.741
3	11.67±0.21	11.50±0.37	11.75±0.38	0.862
4	11.83±0.25	11.92±0.30	12.08±0.33	0.830
5	12.25±0.28	12.17±0.38	12.33±0.36	0.943
6	12.67±0.31	12.58±0.40	12.83±0.28	0.864
7	13.08±0.35	12.92±0.40	13.33±0.36	0.729
8	13.58±0.30	13.42±0.40	13.92±0.35	0.602
9	13.92±0.33	13.67±0.33	14.17±0.31	0.561

Conclusion

On summarizing the overall results of the study, it can be concluded that Malabari goat kids can be successfully reared on dairy based (whey powder and SMP) kid starter by weaning at an early age (45 days) without compromising the growth pattern evaluated on the basis of body biometrics. Moreover, adoption of this practice may improve the farm economy as it spares more quantity of dam's milk for human consumption.

Conflict of Interest

Not available

Financial Support

Not available

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