



## Evaluating Whey-based Milk Replacer as a Sustainable Alternative to Dam's Milk for Malabari Goat Kids

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### ABSTRACT

This study examined the growth and economic outcomes of Malabari kids reared on different milk replacers compared with natural dam's milk. Healthy kids were assigned to four feeding groups: dam's milk, whey-based replacer, groundnut-based replacer, and coconut-based replacer. All kids received colostrum at birth and were reared on the assigned diets until weaning. Key performance indicators included growth rate, feed efficiency, health status, and cost of feeding. Kids raised on dam's milk and whey-based replacer showed better growth and feed efficiency than those on groundnut or coconut-based replacers. Health parameters remained comparable across groups, though digestive issues were more frequent in oilcake-based diets. The whey-based replacer proved to be the most cost-effective option, offering a sustainable and practical alternative to dam's milk for smallholder goat production.

### HIGHLIGHTS

- Whey-based replacers match dam's milk in growth and weight gain.
- Whey-fed kids show the best feed efficiency and health stability.
- Whey replacers reduce rearing costs by 76% compared to milk.

**Keywords:** Economic viability, growth performance, health management, malabarikids, milk replacers

Goat farming is a vital livelihood activity for smallholders in India, contributing milk, meat, fiber, and supplementary income. Among indigenous breeds, Malabari goats are highly valued for their prolificacy, adaptability, and efficient performance under low-input tropical systems (Verma *et al.*, 2009). However, kid rearing remains a bottleneck, with productivity strongly influenced by early-life nutrition (Bharti *et al.*, 2012).

Doe's milk is the gold standard for kid nutrition due to its balanced composition (Park *et al.*, 2007). Yet, the rising demand and high price of goat milk for human consumption challenge its use for exclusive kid rearing.

Milk replacers, designed to mimic doe's milk, provide a potential solution (Zamuner *et al.*, 2023). Whey-based replacers are particularly promising given their digestibility and nutrient profile (Keskin and Biçer, 2002). Alternatives based on oilcakes (groundnut, coconut) are cheaper but may compromise nutrient balance and palatability.

Comparative studies on different replacers in tropical

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breeds like Malabari goats are limited. This study evaluates the effects of whey-, groundnut-, and coconut-based replacers on growth, health, and economics of Malabari kids, aiming to generate evidence-based recommendations for smallholder systems.

## MATERIALS AND METHODS

The study involved twenty-four healthy Malabari kids, each aged four days, selected from the University Goat and Sheep Farm, College of Veterinary and Animal Sciences, Mannuthy. Kids were randomly allocated into four groups ( $n = 6$  per group) with similar initial body weights. Each group was managed under identical environmental and management conditions throughout the experimental period of two months.

Kids in each group received diets as follows; T1 (Control): Dam’s milk, T2: Whey-based milk replacer, T3: Groundnut oilcake-based milk replacer and T4: Coconut oilcake-based milk replacer.

All milk replacers were formulated to provide 25% crude protein and 70% total digestible nutrients (TDN) using locally available ingredients. Milk replacers were reconstituted at a ratio of 1:10 (powder to water), freshly prepared before each feeding, and fed four times daily via bottle feeding.

Kids received colostrum for the first three days. Subsequently, experimental diets were introduced from day four until two months of age. Milk or milk replacer was fed at approximately 1/6 of body weight during the first month, adjusted to 1/8 of body weight during the second month. Fresh water was continuously available. Starter concentrate and fresh green fodder were offered from the 15<sup>th</sup> day onwards.

Growth Performance Parameters calculated were, Body weight - Weekly body weights were recorded to calculate average daily gain (ADG), Body measurements - measurements included body length, heart girth, and height at withers, Feed intake- daily dry matter intake and Feed Conversion Efficiency (FCE), Calculated as kilograms of feed consumed per kilogram of weight gain.

Blood samples collected at the end of the study were analyzed for hemoglobin, serum glucose, calcium, phosphorus, and plasma total protein. Faecal consistency was assessed daily based on a standardized faecal consistency scoring system. Daily health monitoring for signs of illness such as enteritis, respiratory issues, and bloat was also practiced.

The economic viability of each dietary treatment was evaluated based on feed cost per kilogram of weight gain.

Growth and health data were statistically analyzed using one-way ANOVA with Tukey’s post hoc tests. Non-parametric data, such as faecal consistency scores, were analyzed using Kruskal-Wallis tests. Analyses were performed using SPSS statistical software version 20.0.

## RESULTS

Kids fed dam’s milk (T1) and whey-based replacer (T2) showed significantly higher ( $p < 0.05$ ) final body weight and average daily gain compared to those on groundnut- (T3) and coconut-based replacers (T4) (Table 1). The superior feed conversion efficiency (FCE) observed in T2 ( $1.34 \pm 0.04$  kg feed/kg gain) highlights the efficient nutrient utilization of whey replacers. These results demonstrate that whey replacer can effectively match dam’s milk in

**Table 1:** Growth Performance of Malabari Kids

Treatment	Final Body Weight (kg)	Average Daily Gain (kg/day)	Feed Conversion Efficiency (kg feed/kg gain)
T1 (Dam’s Milk)	$5.82 \pm 0.41^a$	$0.063 \pm 0.003^a$	$1.73 \pm 0.10^b$
T2 (Whey-based)	$5.73 \pm 0.14^a$	$0.062 \pm 0.001^a$	$1.34 \pm 0.04^a$
T3 (Groundnut-based)	$4.92 \pm 0.28^b$	$0.049 \pm 0.01^b$	$1.56 \pm 0.11^b$
T4 (Coconut-based)	$4.76 \pm 0.21^b$	$0.047 \pm 0.002^b$	$1.65 \pm 0.03^b$
P-Value	0.024*	0.004**	0.013*

\* Significant at 0.05 level ( $P < 0.05$ ), \*\* Highly Significant at 0.01 level ( $P < 0.01$ ), <sup>a,b</sup>Mean values with different superscripts in a column differs significantly.

**Table 2:** Haemato-biochemical Parameters

Parameters	Dietary Treatments <sup>#</sup>				Pvalue
	T1	T2	T3	T4	
Blood haemoglobin, g/dl	9.27 ± 0.49	9.73 ± 0.25	9.32 ± 0.36	9.42 ± 0.35	0.812 <sup>ns</sup>
Plasmatotal protein, g/dl	6.55 ± 0.10	6.84 ± 0.19	7.06 ± 0.26	6.57 ± 0.14	0.182 <sup>ns</sup>
Calcium, mg/dl	9.24 ± 0.21	9.41 ± 0.22	9.59 ± 0.30	9.80 ± 0.29	0.480 <sup>ns</sup>
Phosphorus, mg/dl	6.32 ± 0.13	6.36 ± 0.37	7.11 ± 0.33	6.75 ± 0.54	0.418 <sup>ns</sup>
Glucose, mg/dl	64.07 ± 0.92	66.42 ± 1.20	64.37 ± 1.57	65.42 ± 0.97	0.507 <sup>ns</sup>
BUN, mg/dl	21.50 ± 3.00	20.18 ± 3.56	25.17 ± 3.76	26.85 ± 4.06	0.541 <sup>ns</sup>

<sup>#</sup> Average of six-values with SE, ns-non significant at P>0.05.

supporting kid growth, consistent with earlier findings on nutrient digestibility and growth response in young goats (Galina *et al.*, 1995; Keskin & Biçer, 2002). In contrast, reduced growth with T3 and T4 may be attributed to lower digestibility and amino acid imbalances typical of oilcake-based replacers (Moran, 2002).

Haemoglobin, glucose, calcium, phosphorus, and plasma protein levels did not differ significantly across treatments (Table 2), suggesting that the replacers maintained normal physiological status. These results indicate the safety and adequacy of whey replacers, aligning with previous studies that reported no adverse effects on blood metabolites in kids fed milk replacers (Keskin & Biçer, 2002).

### Disease Incidence

Health monitoring revealed a higher occurrence of enteritis and bloat in T3 and T4 compared to T1 and T2 (Table 3).

**Table 3:** Disease Incidence by Treatment

Diseases	Percentage of the total occurrence			
	T1	T2	T3	T4
Enteritis	20	25	25	30
Respiratory illness	20	20	30	30
Bloat	0	25	25	50

Notably, bloat incidence reached 50% in the coconut replacer group. This pattern may reflect higher fiber content and reduced digestibility of oilcake-based diets, predisposing kids to gut disturbances. Similar observations have been reported where unbalanced milk replacer formulations were linked to gastrointestinal issues (Moran,

2002). By contrast, whey replacer maintained gut health comparable to dam's milk, reinforcing its nutritional suitability.

Economic analysis showed a substantial advantage for whey replacer, with feed cost per kilogram gain (₹ 139.60 ± 0.78) nearly 76% lower than dam's milk (₹ 580.02 ± 1.85) (Table 4). This dramatic reduction emphasizes the potential of whey replacers to improve profitability in smallholder systems, where goat milk is often diverted for human consumption. Groundnut- and coconut-based replacers offered moderate cost savings but were limited by reduced growth efficiency and higher disease risk.

**Table 4:** Feed Cost per Kilogram Weight Gain

Treatment	Feed Cost (₹/ Kg gain)
T1 (Dam's Milk)	580.02 ± 1.85 <sup>a</sup>
T2 (Whey-based)	139.60 ± 0.78 <sup>b</sup>
T3 (Groundnut-based)	176.94 ± 0.34 <sup>b</sup>
T4 (Coconut-based)	179.78 ± 0.85 <sup>b</sup>

The present study confirms the suitability of whey-based milk replacers as an effective, nutritionally adequate, and economically viable alternative to dam's milk in rearing Malabari kids. Utilizing whey-based milk replacers can significantly lower feeding costs without compromising growth performance or health parameters, thus enhancing the sustainability and profitability of goat farming enterprises. Further research aimed at optimizing groundnut- and coconut-based replacers through improved nutritional formulations may broaden their applicability as cost-effective alternatives in goat production systems.



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