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# Feeding effect of *Moringa oleifera* meal on growth performance in weaned Surti kids

**YG Patel, SV Shah, PR Pandya, KN Wadhwani and DJ Parmar**

**Abstract**
Farm born Surti kids (n=24) were offered TMR having *Moringa oleifera* meal which was replaced with compound concentrate mixture to observe feed intake and growth performance The experiment was carried out for 154 days at Livestock Farm Complex, Veterinary College, KU, Anand by dividing animals in to four treatment groups and offered TMR having composition of 70% Jowar Hay + 30% Compound Concentrate mixture (CCM; $T_1$), 70% Jowar Hay + 22.5% Compound Concentrate mixture + 7.5% *Moringa oleifera* meal ($T_2$; 25% replacement), 70% Jowar Hay + 15% Compound Concentrate mixture + 15% *Moringa oleifera* meal ($T_3$; 50% replacement) and 70% Jowar Hay + 30% *Moringa oleifera* meal ($T_4$; 100% replacement). The average DMI (g/d) of all the Surti kids was recorded as 570.08±18.82, 615.11±15.15, 558.06±17.29 and 643.53±13.98 for $T_1$, $T_2$, $T_3$ and $T_4$ groups, respectively. Significantly higher ($p$<0.05) average DMI (% BW) was recorded in $T_2$ (3.87±0.06) and $T_4$ (3.85±0.05) groups compared to $T_3$ (3.55±0.07) and $T_1$ (3.44±0.06). The average FCR of experimental kids was similar in different treatment with 24.53±4.82, 21.25±3.82, 34.71±7.08 and 19.64±3.37 in $T_1$, $T_2$, $T_3$ and $T_4$ groups, respectively. The average daily body weight gain (g/head/d) of kids in different experimental groups was recorded at par *viz.*, $T_1$ (72.44±7.69), $T_2$ (67.13±6.06), $T_3$ (60.76±6.89) and $T_4$ (66.10±5.35).

**Keywords:** Feed intake, growth, *Moringa oleifera*, nutrient intake, Surti kids

## Introduction
Sheep and goats were known to be first domesticated livestock species. Since then, humans are managing them mainly with extensive system of raising. Goat farming needs less initial capital investment and starts income early and less market risk. There is no religious taboo for their meat, requires less space to occupy and can be utilised for dual (milk & meat) purpose with managemental skills. Goat accounts for 27.74% (148.88 million) of total (536.76 million) livestock population, with an increase of 10.14% over previous census (GOI, 2019) [4].
Protein rich feeds promote rapid growth, reduce ruminal methane production and increase propionate production helping in lowering energy loss and contributing to higher efficiency of nutrient utilization (McDonald *et al.*, 1996) [8]. Since last decade, various trials have been conducted by scientists to witness the productive performance and health status of animal feeding on unconventional feed resources, tree leaves and fodder supplements. Utilization of agro-industrial by products/wastes, fodder trees and shrubs could be a potential strategy for increasing the quality and availability of feeds for resource limited livestock farmers during dry season. The trees provide a good and cheap source of protein and micronutrients (Moyo *et al.*, 2012) [10].
In last decade, many trials were carried out on livestock specially on ruminant and in that particularly small ruminant as they are browsier and graziers left by the livestock owner in extensive way. *Moringa oleifera* leaves have good feed intake, better feed conversion ratio, improves body weight gain, maintains normal physiological and hematological parameters and efficient digestibility as compared to other tree leaves and shrubs (Srivastav, 2019) [15] that used as a feed source by small ruminants. All these finally improves the productive parameters of goats.

## Materials and Methods
The present experiment was conducted on livestock farm complex, College of Veterinary Sci. & A. H., KU, Anand taking twenty-four farm born Surti kids which were grouped into four treatment group based on body weight (having 3 males and 3 females). The animals were offered *ad-libitum* TMR having different inclusion rate of *Moringa oleifera* (Table 1), for a period of 154 days followed by 30 days of adaptation period.

TMR was offered to the kids individually, *i.e.*, 300 g in the morning (10:30 am) mixing thoroughly with 200 g of succulent Hybrid Napier and 200 g in the afternoon (2:00 pm). The extra allowance (100 g) of TMR was offered individually at the evening (6.00 pm) after observation of individual kid's leftover. The offered quantity of TMR was increased gradually with the advancement in the age of the kids and daily observation from individual's left over. Mineral mixture was offered to the experimental animals at the rate of 2% of offered feed. During morning release of kids in the experimental shed, they were able to drink *ad libitum* water from water trough and later on *Ad libitum* wholesome water was offered to the kids in a plastic tub, *i.e.*, 2:00 pm and 5:00 pm.

**Table 1:** Treatment groups and composition of TMR (Total Mixed Ration)

| **Treatment (T)** | **Number of Animals** | **Composition of Total Mixed Ration** | **CCM replacement rate (%)** |
|---|---|---|---|
| $T_1$ | 6 | 70% Jowar Hay + 200 g succulent Hybrid Napier + 30% Compound Concentrate mixture (CCM). | 0 |
| $T_2$ | 6 | 70% Jowar Hay + 200 g succulent Hybrid Napier + 22.5% CCM + 7.5% *Moringa oleifera* meal (25% replacement). | 25 |
| $T_3$ | 6 | 70% Jowar Hay + 200 g succulent Hybrid Napier + 15% CCM + 15% *Moringa oleifera* meal. | 50 |
| $T_4$ | 6 | 70% Jowar Hay + 200 g succulent Hybrid Napier + 30% *Moringa oleifera* meal. | 100 |

The body weight (kg) of all the experimental animals was recorded individually at fortnightly interval prior to morning feeding and watering using electronic weighing machine to know the status of body weight of experimental animals throughout the experimental period.

## Results and Discussion

### Feed Intake

**Dry matter intake (DMI, g/d & % BW):** Dry matter intake (DMI) is a critical determinant of energy intake and performance by ruminants. Irrespective of treatments and periods, overall average DMI of Surti kids throughout the experiment was found to be 596.69±8.48 g/d and 3.68±0.03% BW (Table 2 and Figure 1).

**Table 2:** Effect of feeding *Moringa oleifera* meal on DMI (g/d) of experimental animals

| **Period** | **Treatment** | | | | **Mean (P)** |
|---|---|---|---|---|---|
| | **$T_1$** | **$T_2$** | **$T_3$** | **$T_4$** | |
| $P_1$ | 425.60±18.87 | 490.99±34.83 | 427.47±20.60 | 532.08±33.01 | 469.04$^{ab}$±15.12 |
| $P_2$ | 394.12±32.12 | 470.79±27.29 | 422.24±40.55 | 514.58±31.10 | 450.43$^{a}$±17.11 |
| $P_3$ | 404.39±31.29 | 486.48±9.79 | 422.19±55.50 | 515.40±25.81 | 457.11$^{ab}$±17.61 |
| $P_4$ | 451.25±47.87 | 505.08±16.43 | 458.83±39.85 | 560.34±17.13 | 493.87$^{ab}$±16.89 |
| $P_5$ | 516.69±40.87 | 547.66±21.83 | 493.63±38.08 | 586.26±19.99 | 536.06$^{c}$±15.33 |
| $P_6$ | 608.26±41.76 | 628.53±20.58 | 571.97±31.02 | 641.48±22.60 | 612.56$^{d}$±14.01 |
| $P_7$ | 627.17±33.61 | 678.50±20.55 | 589.09±27.46 | 710.80±19.29 | 651.39$^{d}$±14.74 |
| $P_8$ | 667.84±26.27 | 687.81±15.18 | 670.02±17.42 | 708.86±15.63 | 683.63$^{e}$±8.88 |
| $P_9$ | 667.95±49.77 | 697.15±36.19 | 618.22±48.23 | 711.87±16.93 | 673.80$^{e}$±18.65 |
| $P_{10}$ | 719.67±35.33 | 760.14±16.33 | 714.87±36.99 | 775.77±10.64 | 742.61$^{f}$±12.89 |
| $P_{11}$ | 787.92±37.85 | 813.10±31.22 | 750.16±45.01 | 821.34±13.43 | 793.13$^{g}$±15.62 |
| Mean | 570.08$^{wx}$±18.82 | 615.11$^{y}$±15.55 | 558.06$^{w}$±17.29 | 643.53$^{z}$±13.98 | 596.69±8.48 |

Mean with different superscripts in row (w and z) and column (a to g) differ significantly ($p$<0.05).

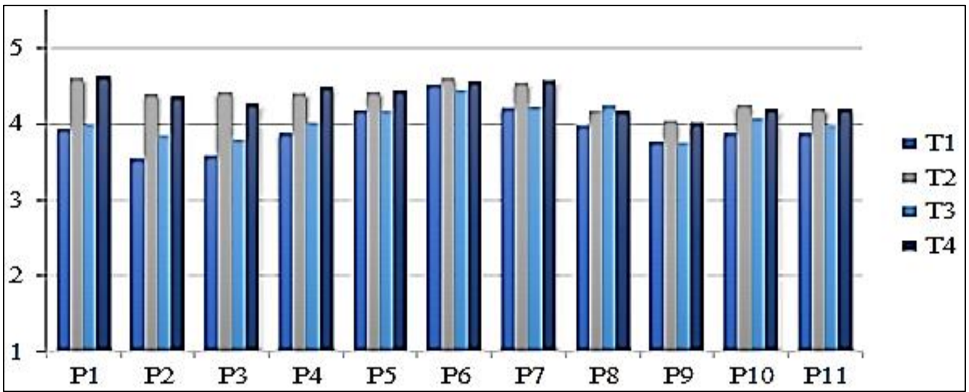


**Fig 1:** Effect of feeding *Moringa oleifera* meal on DMI (% BW) of experimental animals

The feed intake in terms of DMI (g/d) of the animals differed significantly ($p$<0.05) between experimental groups for treatment and period, when fed with *Moringa oleifera* meal at different inclusion rates and recorded as 570.08±18.82, 615.11±15.15, 558.06±17.29 and 643.53±13.98 for $T_1$, $T_2$, $T_3$ and $T_4$ groups, respectively.

Sultana *et al.* (2015) [16] in Bengal goats (569.59 to 646.51 g/d), Syed (2017) [17] in local kids (635.0±31.7 *vs* 612.8±28.4

g/d) and Sayed-Ahmed *et al.* (2018) [14] in Baladi does (668 to 687 g/d) had similar body weight of experimental animals to present study.

Higher DMI intake as compared to present study was recorded by Kholif *et al.* (2015) [5] in lactating Anglo-Nubian goats (730.8 to 848.7 g/d) and Babeker and Abdalbagi (2015) [1] in Sudan Nubian goats (up to 1580 g/d). All of these studies were carried out in exotic goats breeds and started with higher initial average body weight that might be the reason of higher dry matter intake compared to present study in addition to that, researches were carried on lactating does and so their dry matter requirement is always higher compared to our animals which are kids.

Similarly, lower DMI compared to present study was observed by Damor *et al.* (2017) [3] in Mehsana kids (117.04±4.80 to 123.3±4.34/d), Patel *et al.*, (2020) [12] in Mehsana kids (324.0±13.4 to 335.9±7.9 g/d) and Pandey (2021) [11] in Surti kids (317.97±8.45 vs 324.94±5.94 vs 339.38±7.01 g/d). The reason of lower DMI in these studies might be due to initiation of experiment with lower animal body weight and shorter experimental period compared to present trial.

DMI (%BW) of the experimental animals showed significant ($p<0.05$) difference. Significantly higher ($p<0.05$) average DMI (% BW) was recorded in $T_2$ (3.87±0.06) and $T_4$ (3.85±0.05) groups as compared $T_3$ (3.55±0.07) and $T_1$ (3.44±0.06). The DMI (% BW) increased significantly ($p<0.05$) to the tune of 12.69 and 11.34% in $T_2$ and $T_4$ while of $T_3$ numerically higher by 2.55% as compared to control group (Figure 1).

The average FCR (g/g BW gain) of experimental animals was recorded as 24.53±4.82, 21.25±3.82, 34.71±7.08 and 19.64±3.37 in $T_1$, $T_2$, $T_3$ and $T_4$ groups, respectively (Table 3).

**Table 3:** Effect of feeding *Moringa oleifera* meal on DMI/BW gain (g/g BW gain) of experimental animals

| Period | Treatment | | | | Mean (P) |
|---|---|---|---|---|---|
| | $T_1$ | $T_2$ | $T_3$ | $T_4$ | |
| $P_1$ | 68.53±40.42 | 32.04±10.07 | 125.95±34.30 | 13.23±3.35 | $59.94^{d}$±14.62 |
| $P_2$ | 20.64±3.44 | 60.00±28.43 | 23.59±7.64 | 49.86±28.53 | $38.52^{bc}$±9.47 |
| $P_3$ | 50.42±15.38 | 27.86±7.16 | 35.87±5.54 | 22.46±4.23 | $34.15^{bc}$±4.49 |
| $P_4$ | 59.08±26.29 | 21.16±6.69 | 54.40±24.91 | 35.01±17.76 | $42.41^{cd}$±9.30 |
| $P_5$ | 20.18±6.63 | 10.30±2.98 | 84.50±54.67 | 23.47±15.31 | $34.61^{bc}$±13.66 |
| $P_6$ | 13.97±5.90 | 7.31±0.86 | 13.44±4.38 | 12.14±3.32 | $11.72^{a}$±1.82 |
| $P_7$ | 5.16±0.41 | 6.34±0.52 | 6.72±0.83 | 5.95±0.41 | $6.04^{a}$±0.27 |
| $P_8$ | 4.25±0.65 | 5.04±0.49 | 5.33±1.41 | 5.55±0.42 | $5.04^{a}$±0.37 |
| $P_9$ | 8.25±0.51 | 14.09±3.31 | 15.51±4.74 | 12.70±2.60 | $12.64^{a}$±1.47 |
| $P_{10}$ | 13.03±1.97 | 42.00±26.64 | 9.18±0.85 | 24.50±9.42 | $22.18^{ab}$±6.61 |
| $P_{11}$ | 6.29±1.21 | 7.58±1.13 | 7.29±0.63 | 11.13±2.03 | $8.07^{a}$±0.69 |
| Mean | 24.53±4.82 | 21.25±3.82 | 34.71±7.08 | 19.64±3.37 | 25.03±2.50 |

Mean with different superscripts in column (a to d) differ significantly ($p<0.05$)

The result revealed non-significant difference for FCR between control and *Moringa oleifera* meal supplemented groups. Non-significantly improved FCR was recorded in *Moringa oleifera* meal supplemented group $T_4$ (19.93%) and $T_2$ (13.37%) except for $T_3$, where it diminished by 41.50% as compared to control group. Higher the value of the feed conversion ratio, the less desirable is the diet, as the animal consumes more feed to produce a unit weight gain (Tona *et al.*, 2014) [18]. Hence, in the present experiment the feed was better utilized at 100 and 25% level of *Moringa oleifera* meal inclusion. Tona *et al*. (2014) [18] in West African Dwarf goats (16.78 to 22.29) and Padney (2021) in Surti kids (17.40 to 21.11) reported similar results to present findings.

In yearling Sudan Nubian goats by Babeker and Abdalbagi (2015) [1], in Bengal goats by Sultana *et al.* (2015) [16], in local goats by Syed (2017) [17], in Baladi kids by Sayed-Ahmed and Shaarawy (2019) [13] showed improved results as compared to present study. Animals taken in all these studies were exotic and having higher growth rate compared to Indigenous breeds which are also facing environmental effects, that might be the reason for better FCR as compared to present study.

The average water intake (ml/d) in $T_1$, $T_2$, $T_3$ and $T_4$ was found to be 1356.97±102.87, 1193.03±76.61, 1233.86±86.18 and 1318.64±74.70, respectively (Figure 2). Significantly ($p<0.05$) higher water intake was recorded in $T_1$ as compared to $T_2$ and $T_3$ while found comparable with $T_4$. Period effect was observed ($p<0.05$) but P×T interaction showed no effect. Babeker and Abdalbagi (2015) [1] in lactating Nubian goats (1130 to 1460 ml/d) reported comparable water intake (ml/d) as compared to present result.

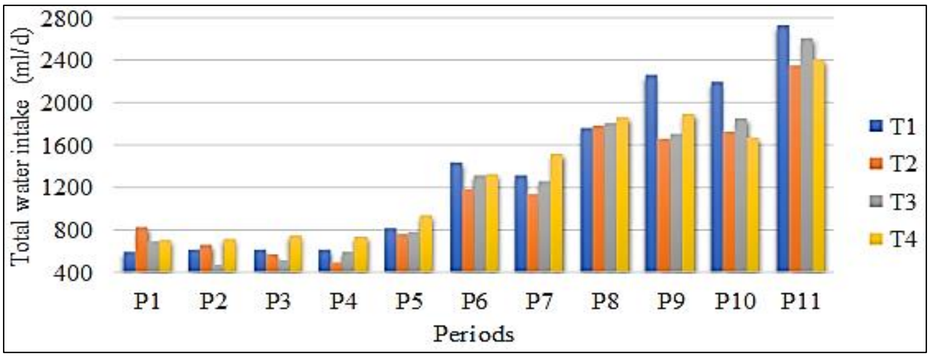


**Fig 2:** Effect of feeding *Moringa oleifera* meal on total water intake (ml/d) of experimental animals

**Body weight gain**

Irrespective of treatments, average body weight at beginning and then at the end of experiment was recorded as 12.08±0.30 and 22.35±0.50 kg, respectively (Table 4). The body weight of kids increased by 85.02% (10.27 kg), during the experimental period of 154 days. The final body weight of experimental kids differed significantly ($p$<0.05) where it was recorded 23.37±1.37, 22.03±0.90, 21.56±0.99 and 22.43±1.21 kg for $T_1$, $T_2$, $T_3$ and $T_4$ treatments, respectively. As expected, in the present study also, period and treatment influenced ($p$<0.05) the body weight of the trial Surti kids.

**Table 4:** Effect of feeding *Moringa oleifera* meal on body weight (kg) of experimental animals

| Period | Treatment | | | | Mean (P) |
|---|---|---|---|---|---|
| | $T_1$ | $T_2$ | $T_3$ | $T_4$ | |
| $P_0$ | 12.22±0.65 | 11.69±0.72 | 12.20±0.54 | 12.25±0.89 | 12.08±0.30 |
| $P_1$ | 12.63±0.71 | 12.12±0.74 | 12.47±0.63 | 13.01±0.83 | 12.56$^a$±0.32 |
| $P_2$ | 13.04±0.66 | 12.30±0.74 | 12.78±0.58 | 13.34±0.79 | 12.86$^a$±0.31 |
| $P_3$ | 13.19±0.64 | 12.62±0.70 | 12.95±0.57 | 13.73±0.85 | 13.12$^{ab}$±0.31 |
| $P_4$ | 13.39±0.62 | 13.07±0.67 | 13.18±0.58 | 14.18±0.84 | 13.46$^{ab}$±0.31 |
| $P_5$ | 14.03±0.51 | 14.09±0.65 | 13.46±0.49 | 15.01±0.97 | 14.15$^b$±0.31 |
| $P_6$ | 15.12±0.68 | 15.36±0.64 | 14.48±0.53 | 15.95±0.94 | 15.23$^c$±0.32 |
| $P_7$ | 16.88±0.75 | 16.91±0.68 | 15.80±0.67 | 17.67±0.96 | 16.81$^d$±0.36 |
| $P_8$ | 19.29±0.92 | 18.90±0.72 | 17.96±0.59 | 19.51±1.06 | 18.91$^e$±0.38 |
| $P_9$ | 20.44±0.96 | 19.75±0.75 | 18.91±0.80 | 20.46±1.15 | 19.89$^{ef}$±0.42 |
| $P_{10}$ | 21.33±1.10 | 20.35±0.72 | 20.05±0.93 | 21.24±1.07 | 20.74$^f$±0.43 |
| $P_{11}$ | 23.37$^z$±1.37 | 22.03$^x$±0.90 | 21.56$^x$±0.99 | 22.43$^y$±1.21 | 22.35$^g$±0.50 |

Mean with different superscripts in row (x and y) and column (a to g) differ significantly ($p$<0.05).

Babeker and Abdalbagi (2015) [1] in Sudan Nubian yearling goats (10-12 months) reported 20.30 ± 2.17 kg (0%), 27.00 ± 0.78 kg (20%) and 23.10 ± 1.00 kg (50%) body weight ($p$<0.05), which was similar to present study. Meel *et al.* (2018) [9] in Sirohi goats (20.27 *vs* 22.04 *vs* 24.73 *vs* 25.77 *vs* 24.23 kg; $p$<0.05) and Mataveia *et al.* (2019) [7] in Indigenous does (21.3, 22.5, 25.4, 24.2, 21.6, 24.9 and 22.6 kg; $p$>0.05) also reported equivalent results with present study. The positive effect of supplementation with *Moringa oleifera* on growth performance observed in present study was due to the supply of superior quality protein from feed source. Forage species, in the tropics and sub-tropics, mature and become fibrous rapidly, resulting in poor quality forage, so instead of using forage crops, moringa can be a better option as the plant is also having draught resistant property.

Better results compared to presents study were reported by Mahmoud (2013) [6] in growing lambs (49.71 *vs* 50.10 *vs* 48.05 kg) and Sayed-Ahmed *et al.* (2018) [14] in Baladi does (27.33 *vs* 29.60 *vs* 30.87 kg) with significant ($p$<0.05) difference between treatment and control groups.

Damor *et al.* (2017) [3] in Mehsana kids (14.56 *vs* 15.04 *vs* 15.73 kg) and Choudhary *et al.* (2018) [2] in Bengal goats (12.04 *vs* 10.58 *vs* 11.58 kg) recorded non-significant and lower body weight in their experiments. Poor results recorded in above studies might be due to unequal nitrogen balance and shorter adaptation & trial period that interfere with the adaptability of animals with the trial feed as reported by the authors.

The overall average daily gain of kids regardless of groups and period over the entire experimental period was 66.61±3.27 g/head/d (Table 5). ADG (g/head/d) of kids in different experimental groups was recorded at par with numerically higher in $T_1$ (72.44±7.69) followed by $T_2$ (67.13±6.06), $T_4$ (66.10±5.35) and $T_3$ (60.76±6.89).

**Table 5:** Effect of feeding *Moringa oleifera* meal on average daily body weight gain (g) in experimental animals

| Period | Treatment | | | | Mean (P) |
|---|---|---|---|---|---|
| | $T_1$ | $T_2$ | $T_3$ | $T_4$ | |
| $P_1$ | 29.29±9.54 | 30.70±14.17 | 18.91±10.80 | 54.71±15.14 | 33.40$^a$±6.05 |
| $P_2$ | 29.05±14.50 | 12.62±2.70 | 22.32±4.27 | 23.57±8.11 | 21.89$^a$±3.91 |
| $P_3$ | 11.07±2.55 | 23.04±5.98 | 12.38±1.63 | 27.68±6.62 | 18.54$^a$±2.49 |
| $P_4$ | 14.34±5.34 | 32.20±7.50 | 16.67±5.88 | 31.85±9.53 | 23.76$^a$±3.55 |
| $P_5$ | 45.59±15.99 | 72.80±17.37 | 19.52±8.79 | 59.35±15.91 | 49.32$^b$±7.58 |
| $P_6$ | 77.50±22.30 | 91.13±10.86 | 73.27±23.91 | 67.56±14.73 | 77.37$^c$±8.21 |
| $P_7$ | 125.77±14.54 | 110.06±9.74 | 94.29±13.34 | 122.44±10.49 | 113.14$^d$±5.81 |
| $P_8$ | 172.44±24.99 | 142.38±14.41 | 153.75±29.21 | 131.43±11.99 | 150.00$^e$±9.67 |
| $P_9$ | 82.08±7.91 | 60.71±12.54 | 67.92±26.78 | 68.39±15.93 | 69.78$^c$±7.55 |
| $P_{10}$ | 63.92±13.91 | 43.21±12.91 | 81.73±10.40 | 55.36±16.15 | 61.06$^{bc}$±6.47 |
| $P_{11}$ | 145.71±27.22 | 119.58±20.01 | 107.62±14.41 | 84.82±15.01 | 114.43$^d$±9.64 |
| Mean | 72.44±7.69 | 67.13±6.06 | 60.76±6.89 | 66.10±5.35 | 66.61±3.27 |

Mean with different superscripts in column (a to d) differ significantly ($p$<0.05)

Analogous conclusions to current study were stated by Sultana *et al.* (2015) [16] in Bengal goats (33.02 *vs* 60.32 *vs* 63.45 *vs* 57.27 *vs* 51.57 g/head/d) and Damor *et al.* (2017) [3] in Mehsana kids (50.36±0.70 *vs* 54.60±0.70 *vs* 61.12±0.2) in different groups but with significant improvement ($p$<0.05) in treatment (*Moringa oleifera* supplemented) groups as compared to control group. Significantly lower ADG recorded in control group in these studies might be due to unequal nitrogen content in offered feed as reported by the authors.

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