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Effect of feeding forage cactus on growth performance of crossbred heifers

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Abstract

The present investigation entitled “Utilization of forage cactus on growth performance of crossbred heifers”, was carried out at Research Cum Development Project (RCDP) on Cattle, Department of Animal Husbandry and Dairy Science, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra, India for the period of 90 days. Twenty crossbred heifers of above eleven months age were selected for the experiment and distributed into four treatments viz., T₀ (control), T₁ (Concentrate + dry roughages + forage cactus 10% replacing green fodder on DM basis), T₂ (Concentrate + dry roughages + forage cactus 20% replacing green fodder on DM basis) and T₃ (Concentrate + dry roughages + forage cactus 30% replacing green fodder on DM basis). The feeding trial was conducted for the period of three months. Feed samples and faeces of different treatments were collected and chemically analysed. The nutritive value of forage Cactus was 15.50, 6.60, 1.08, 20.05, 41.17, 15.60 and 78.61 per cent DM, CP, EE, total ash, NFE, CF and IVDMD respectively. The nutritive values of experimental ration ranges between 47.10 to 41.15, 11.33 to 11.67, 3.45 to 2.91, 9.40 to 11.66, 26.63 to 24.83, 49.19 to 48.93 and 62.93 to 64.33 per cent DM, CP, EE, TA, CF, NFE and IVDM in treatment T₀ to T₃. Average daily feed intake was 11.13, 12.02, 11.51 and 11.35 kg per day whereas average feed intake per 100 kg body weight was 7.69, 7.98, 7.85 and 7.83 kg in T₀, T₁, T₂ and T₃, respectively. The daily feed intake (kg) per day per heifer was statistically significant ($p < 0.05$) among different treatment. Daily dry matter intake was 4.29, 4.42, 4.20 and 3.93 kg per day per heifer whereas average DM intake per 100 kg body weight was 2.97, 2.94, 2.87 and 2.72 kg in T₀, T₁, T₂ and T₃, respectively. Feed consumption difference due to different treatments were found to be statistically significant ($p < 0.05$). The water intake of heifer per day was significantly ($p < 0.05$) higher in treatment T₀ (13.84 lit.) over the rest of treatment i.e. T₁, T₂ and T₃. Weekly water intake of heifer was found to be significantly higher in treatment T₀ (96.88) and T₁ (86.84) group of heifers than T₂ and T₃ group of heifers, whereas, the treatment T₁ and T₂ were at par with each other. This might be due to feeding forage cactus that contained more moisture which was not fed in the T₀ group. Significant ($p < 0.05$) effect on the body weight of the crossbred heifers was observed among different treatments. Total body weight (kg) gain per heifer was 36.80, 44.60, 40.20 and 37.80 kg in treatment T₀, T₁, T₂ and T₃, respectively. The variation among different treatment groups was found to be significantly ($p < 0.05$) higher in treatment T₁. Whereas, treatment T₀, T₂ and T₃ were at par with each other. The average chest girth gain over an experimental period was 8.40, 15.80, 12.00 and 9.00 cm in T₀, T₁, T₂ and T₃ treatments, respectively. The variation among different treatment groups was found statistically significant ($p < 0.05$). The chest girth gain was found significantly higher in treatment T₁ (15.80 cm) followed by treatment T₂, T₃ and T₀. However, treatment T₃ and T₀ were at par with each other. The average body length gain was 6.14, 11.59, 10.35, and 7.62 cm for T₀, T₁, T₂ and T₃, respectively. The variation among different treatment groups was found statistically significant ($p < 0.05$) for final body length and body length gain. The average body length gain (cm) of heifers was found more in treatment T₁ (11.59) and low in T₀ (06.14). The average body height gain over an experimental period was 09.00, 11.40, 10.00 and 9.20 for T₀, T₁, T₂ and T₃, treatments, respectively. The variation among different treatment groups was found statistically significant ($p < 0.05$). The average body height gain of crossbred heifers was found significantly ($p < 0.05$) higher in T₁ (11.40) whereas, treatment T₂, T₃ and T₀ were at par with each other.

Keywords: Forage cactus, crossbred heifers, growth performance, digestibility

Introduction

India is an agricultural country and livestock plays an important role in Indian agriculture. About 70% of the total population are engaged in agriculture and rearing livestock mainly, cattle and buffaloes. In all the livestock, dairy animal is known as an efficient producer of foods for human being.

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India is messed with huge bovine population of 199.9 million cattle and 108.7 million buffaloes accounting for about 47 per cent of Asia and 17 per cent of world's bovine population (Anonymous 2012)^[2].

Almost 53.4 per cent of India's land area comprises arid and semi-arid regions. Farmers of arid zone practices livestock-based farming system, however, the main constraint to livestock farming, is limited and fluctuating availability of feed and water resources (Mathur, 2003)^[10].

Efficient ruminant production system is primarily based on the availability of forage resources. The major constraint hampering the productivity in India has been the scarcity of fodder in dry season and drought situations, coupled with low quality of the available fodder. The arid and semi-arid regions are characterized by limited feed resources, and the production of green fodder, particularly during the hot and dry season (summer) when the animals are strongly complemented by concentrates (Mayer and Cushman, 2019)^[11].

One alternative would be to use cactus pear (*Opuntia ficus indica*), that is easily available as an energy source of low cost. The cactus pear has high water-holding capacity, rich in nutrients and adapted to the environmental conditions of semi-arid areas (Costa *et al.*, 2013)^[6].

Spineless cactus (*Opuntia ficus-indica*) emerges as a potential solution to the shortage of feed and water during prolonged drought due to its efficiency of water use. Cactus is gaining importance as an alternate source of livestock feed in arid and semi-arid zones due to its drought resistance, high bio-mass yield, high palatability, low soil fertility, tolerance to salinity. Spineless cactus has been reported to be a good source of minerals for supplementing to the diet of livestock. Retamal *et al.* (1987)^[14] reported that spineless cactus contains high levels of calcium and magnesium.

Materials and Methods

Location of study

The present investigation entitled "utilization of forage cactus on growth performance of crossbred heifers" was undertaken at Research cum development project on Cattle is located at Department of Animal Husbandry and Dairy Science, MPKV., Rahuri, Dist. Ahilyanagar, Maharashtra (India).

Experimental animals

Twenty growing crossbred heifers of age above 11 months of age were selected. The heifers were divided into four groups. Thus, each group was consisted of five heifers for the study.

Allotment of treatments

The present experiment was conducted by randomized block design with 4 treatments as detailed below in table.

Table 1: Allotment of treatment in feeding trial

Treatment	Details
T ₀	Concentrate + Dry roughages + Green forage.
T ₁	Concentrate + Dry roughages + forage cactus 10% replacing green fodder on DM basis.
T ₂	Concentrate + Dry roughages + forage cactus 20% replacing green fodder on DM basis.
T ₃	Concentrate + Dry roughages + forage cactus 30% replacing green fodder on DM basis.

Records of observation

Daily feed intake

The dry matter consumption of individual heifer under different treatments was determined by recording their daily feed consumption twice a week.

Daily water intake

Fresh and clean water was provided to the experimental heifers throughout the course of investigation. Animals were offered drinking water through measuring bucket twice daily at 9.30 a.m. and 3.30 p.m., daily water intake of each heifer was recorded throughout the investigation period.

Daily dry matter (DM) consumption

The daily feed intake per animal was recorded by providing feed as per treatment during morning and afternoon and subtracting the residue of the feed left in the next day morning.

Body weight

The body weight of experimental animals was recorded at the start of experiment for 3 consecutive days and then at weekly interval.

Body measurement

Chest girth

It was recorded as a circumference of chest measured just behind the elbow point passing through the wither point.

Body height

It was recorded as the perpendicular between the ground level and the point of wither. While measuring the height, the heifers were made to stand easily on four legs on levelled ground.

Body length

It was recorded as the straight-line distance between the point of shoulder and the pin bone.

Statistical method

The data was subjected to the statistical analysis by the Randomized Block Design for testing their difference as per procedure by Amble (1975)^[1].

Results and Discussion

Chemical composition of experimental ration

The DM and CF was significantly ($p < 0.05$) higher in treatment T₀ (47.10) and (26.63) followed by treatment T₁ (45.35) and (26.01), T₂ (43.26) and (25.40) and T₃ (41.15) and (24.83) respectively. The DM was decreased from T₀ to T₃ this may be due to the cactus contains low DM per cent. The chemical composition of EE was significantly higher ($p < 0.05$) in T₀ which was at par with T₁ followed by treatments T₂ and T₃. Total Ash content was 9.40, 10.85, 11.23 and 11.66 per cent in treatments T₀, T₁, T₂ and T₃ respectively, which was significantly ($p < 0.05$) higher in T₁ (10.85) and was at par with T₂ (11.23) and T₃ (11.66). The IVDMD was significantly higher in treatment T₃ (64.33), which was at par with T₂ (63.86) followed by T₁ (63.43) and T₀ (62.93).

Table 2: Chemical composition of experimental ration (% on DM basis)

Treatments	DM (%)	CP (%)	EE (%)	TA (%)	CF (%)	NFE (%)	IVDMD (%)
T ₀	47.10 ^a	11.33	3.45 ^a	9.40 ^b	26.63 ^a	49.19	62.93 ^c
T ₁	45.35 ^b	11.47	3.29 ^{ab}	10.85 ^a	26.01 ^b	48.38	63.43 ^{bc}
T ₂	43.26 ^c	11.59	3.12 ^{bc}	11.23 ^a	25.40 ^c	48.66	63.86 ^{ab}
T ₃	41.15 ^d	11.67	2.91 ^c	11.66 ^a	24.83 ^d	48.93	64.33 ^a
Mean	44.21	11.51	3.19	10.78	25.71	48.79	63.63
F test	Sig	NS	Sig	Sig	Sig	NS	Sig
SE (M)	0.45	-	0.09	0.38	0.17	-	0.26
CD at 5%	1.42	-	0.27	1.18	0.52	-	0.82

Above results are in agreement with Bhagat (2016) reported that per cent DM, CP, CF, EE, NFE and Ash from con-entrated mixture were 89.2, 19.65, 6.55, 60.12 and 7.58 per cent respectively.

Daily feed intake

The overall average daily feed intake of heifers during experiment was 11.13, 12.02, 11.51 and 11.35 kg of feed per day under T₀, T₁, T₂ and T₃ treatment, respectively. Daily feed intake (kg) was observed significantly ($p < 0.05$) higher in treatment T₁ (12.02) and T₂ (11.51) followed by T₃ (11.35)

and T₀ (11.13). Whereas, the treatment T₀, T₂ and T₃ were at par with each other. Thus, this trend clearly specified that the feeding of forage cactus significantly increased the average feed intake of the heifers however it was non-significantly increased on 100 kg body weight.

Similar findings were recorded by Gebremarian *et al.* (2006) while studying on effect of different levels of cactus (*Opuntia ficus indica*) inclusion on feed intake, digestibility and body weight gain in tef (*Eragrostis tef*) straw-based feeding of sheep.

Table 3: Average daily feed intake under different groups (kg/day/heifer)

Treatments	Average body weight	Daily feed intake	Daily feed intake per 100 kg body weight
T ₀	144.60 ^b	11.13 ^b	7.69
T ₁	150.60 ^a	12.02 ^a	7.98
T ₂	146.60 ^b	11.51 ^{ab}	7.85
T ₃	144.80 ^b	11.35 ^b	7.83
Mean	146.65	11.50	7.84
F test	Sig	Sig	NS
SE (M)	1.25	0.16	-
CD at 5%	3.88	0.51	-

Water intake

Average daily water intake over an experimental period was 13.84, 12.12, 11.36 and 10.64 lit/day/heifer in treatment T₀, T₁, T₂ and T₃ group of heifers, respectively. The corresponding values for weekly water intake were 96.88, 86.84, 79.52 and 65.48 lit/week/heifer in treatment T₀, T₁, T₂ and T₃ respectively. The water intake was noticed higher in T₀ followed by T₁, T₂ and T₃. It might be due to the reason that

as the cactus contains more moisture the water intake of the heifers decreased.

These findings are in agreement with following researchers, Ben *et al.* (1996) [4] who reported that when the cactus intake levels were 0, 150, 300, 450, or 600 g on DM basis per day, the water intake levels were 2.42, 1.49, 0.14, 0.11 and 0 kg respectively.

Table 4: Effect of feeding forage cactus on daily and weekly water intake of heifers (lit)

Treatments	Water/day/heifer	Water/week/heifer	Water intake/ 100 kg BW
T ₀	13.84 ^a	96.88 ^a	12.58 ^a
T ₁	12.12 ^b	86.84 ^{ab}	11.02 ^b
T ₂	11.36 ^{bc}	79.52 ^b	10.20 ^{bc}
T ₃	10.64 ^c	65.48 ^c	09.67 ^c
Mean	11.99	82.18	10.86
F test	Sig	Sig	Sig
SE (M)	0.42	4.03	0.37
CD at 5%	1.33	12.54	1.18

Dry matter intake

The average daily dry matter intake was 4.29, 4.42, 4.20 and 3.93 kg per day per heifer in T₀, T₁, T₂ and T₃ groups, respectively for crossbred heifer of average weight 144.60, 150.60, 146.60 and 144.80 kg, respectively under treatment T₀, T₁, T₂ and T₃, respectively. The DM intake was observed significantly ($p < 0.05$) higher in treatment T₁ followed by treatment T₀, T₂ and T₃ group of growing crossbred heifers. The daily dry matter intake per 100 kg body weight of

crossbred heifers of the treatment groups T₀, T₁, T₂ and T₃ were 2.97, 2.94, 2.87 and 2.72 kg, respectively.

The present intake values are at par to the values reported by past research workers like Kumar *et al.* (2017) [12] who observed that the daily intake was 2.72, 2.64 and 2.57 kg per day per calves in T₁, T₂ and T₃ groups respectively. Higher intake of DM per 100 kg body weight was noticed in treatment T₁ and lowest in T₂ and T₃.

Table 5: Effect of feeding forage cactus on total weight of the heifers (kg)

Treatment	Average initial weight	Average final weight	Total weight gain
T ₀	108.00	144.60 ^b	36.80 ^b
T ₁	106.00	150.60 ^a	44.60 ^a
T ₂	107.00	146.60 ^b	40.20 ^b
T ₃	107.00	144.80 ^b	37.80 ^b
Mean	107.00	146.55	39.85
F test	NS	Sig	Sig
SE (M)	-	1.25	1.30
CD at 5%	-	3.88	4.05

Body weight

It was seen from table 4 that, the values observed for total body weight gain per heifer were 36.80, 44.60, 40.20, 37.80 kg in treatment groups T₀, T₁, T₂ and T₃, respectively. The total body weight gain of heifers was affected significantly ($p < 0.05$) by the feeding of forage cactus. The heifers from T₁ treatment exhibited significantly higher total body weight

gain over rest of the treatments, while the heifers from T₀, T₂ and T₃ were at par with each other.

These results are conflicting with results reported by Patil (2018) [13] who observed that the average body weight gain per day per heifers were 0.367, 0.400, 0.453, 0.421 and 0.508 kg in treatment T₁, T₂, T₃, T₄ and T₅, respectively.

Table 5: Effect of feeding forage cactus on body chest girth gain of heifers (cm)

Treatment	Average initial chest girth(cm)	Average final chest girth	Average gain chest girth (cm)
T ₀	110.00	118.40 ^b	08.40 ^c
T ₁	110.40	126.20 ^a	15.80 ^a
T ₂	110.20	122.20 ^{ab}	12.00 ^b
T ₃	110.80	119.80 ^b	09.00 ^c
Mean	110.35	121.65	11.30
F test	NS	Sig	Sig
SE (m)	-	1.82	0.54
CD at 5%	-	5.60	1.69

Body measurement

The total chest girth gain over an experimental period were 08.40, 15.80, 12.00 and 09.00 cm for group of crossbred heifers T₀, T₁, T₂ and T₃ treatments, respectively. The variation among different treatment groups was noticed statistically significant ($p < 0.05$). The chest girth was found significantly more in treatment T₁ (15.80 cm) over the treatment T₂ (12.00), T₃ (09.00) and T₀ (08.40). This mean maximum gain in chest girth of crossbred heifers was obtained as a result of feeding 10 per cent of forage cactus. The chest girth of crossbred heifers observed in this study resembles with, Mishra *et al.* (2017) [12] they observed that the daily gain in chest girth (cm) was higher in treatment T₂ (0.146) followed by T₃ (0.124) and T₁ (0.105) in the treatments respectively in indigenous calves fed with various concentrate mixtures.

Body length

The total body length gain over experimental period were 06.14, 11.59, 10.35 and 07.62 cm in T₀, T₁, T₂ and T₃, respectively. This mean maximum gain in body length of heifers was significantly ($p < 0.05$) higher in treatment T₁ and lower in T₀. The overall average final body length over the experimental period was significantly higher in T₁ (107.99) which was at par with T₂ (104.55) and T₃ (104.22) over the T₀ (99.14). This mean maximum gain in body length of heifers was obtained as a result of feeding 10 per cent forage cactus.

The similar findings of below researchers are in agreement with this study. Dahiwal (2018) [7] observed that the gain in body length was 5.60, 7.45, and 7.30 cm in T₁, T₂, and T₃, respectively. The gain in length was highest in T₂ and lowest in T₁ and T₃ treatments.

Table 6: Effect of feeding forage cactus on body length gain of heifers (cm)

Treatment	Average initial length	Average final body length	Average gain body length
T ₀	93.00	099.14 ^b	06.14 ^d
T ₁	96.40	107.99 ^a	11.59 ^a
T ₂	94.20	104.55 ^{ab}	10.35 ^b
T ₃	96.60	104.22 ^{ab}	07.62 ^c
Mean	95.05	103.97	8.92
F test	NS	Sig	Sig
SE (M)	-	2.35	0.29
CD at 5%	-	7.33	0.92

Body height

The total body height gain over an experimental period were 09.00, 11.40, 10.00 and 09.20 cm for T₀, T₁, T₂ and T₃, respectively. The variation between different treatment groups was found significant ($p < 0.05$). The total body height of heifers was noticed significantly higher in treatment T₁ over the rest of treatment T₂, T₃ and T₀.

These findings were in congruence with, Dahiwal (2018) [7] who reported that the initial body height were 101.48, 104.26 and 104.88 cm in T₁, T₂, and T₃ groups, respectively and final observations of height were 111, 115.82, 114.48 cm in respective treatments. The total gain in the height (cm) of heifers in treatment T₂ group (11.56) was highest followed by T₃ (9.60) and lower in T₁ (9.50).

Table 7: Effect of feeding forage cactus on body height gain of heifers (cm)

Treatment	Average initial height	Average final body height	Average gain body height
T ₀	96.80	105.80 ^b	09.00 ^b
T ₁	98.80	110.20 ^a	11.40 ^a
T ₂	99.20	109.20 ^{ab}	10.00 ^b
T ₃	96.40	105.60 ^b	09.20 ^b
Mean	97.80	107.70	09.90
F test	NS	Sig	Sig
SE (m)	-	1.24	0.37
CD at 5%	-	3.87	1.16

Conclusions

The forgoing results and discussion leads to conclude that

1. The chemical composition of forage cactus 15.50, 6.60, 1.08, 20.05, 41.17, 15.60 and 78.61 per cent DM, CP, EE, Total ash, NFE, CF and IVDMD respectively.
2. Daily feed intake per day was observed significantly ($p<0.05$) higher in T₁ whereas, water intake per day was significantly higher in T₀ than other treatments.
3. Weight of heifers, weight gain per day, chest girth gain, body length gain and body height gain was significantly ($p<0.05$) higher in T₁ and was lower in heifers kept in control group.

Hence, it is concluded that, crossbred heifers can be efficiently raised on feeding of forage cactus with replace the green fodder in diet (T₁) as evident from the increased daily feed intake, water intake and increase the digestibility which is resulted more body weight gain, increase body measurements of heifers and also improving the health of crossbred heifers.

Implications

In our current study, experimental crossbred heifers exhibited significant weight gain and improved body measurements when 10 per cent of green fodder was replaced with forage cactus. This finding suggests that forage cactus holds promise as a beneficial fodder option for crossbred heifers, contributing to a well-balanced nutrient intake.

Moreover, our investigation relished that feeding up to 30 per cent cactus to crossbred heifers during severe scarcity conditions did not result in any adverse effects on their health. Given this lack of negative impact, we recommend that farmers in scarcity-prone areas consider safely supplementing their livestock diets with this resilient forage cactus.

Conflict of Interest

Not available

Financial Support

Not available

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