RESEARCH ARTICLE Asian Journal of Dairy and Food Research, Volume 43 Issue 3: 566-571 (September 2024)

Effect of Concurrent Feeding of Hydroponics Maize Fodder and Probiotic (*Saccharomyces cerevisiae*) on Growth Performance in Gir Calves

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10.18805/ajdfr.DR-1716

ABSTRACT

Background: Technology advancement has introduced hydroponics technology for green fodder production. The present investigation was undertaken to study the growth performance of Gir cattle calves fed hydroponics maize fodder (HMF) with and without supplementation of probiotic (*Saccharomyces cerevisiae*).

Methods: A feeding trial of 120 days was conducted on 36 male Gir calves divided into nine groups. Group T_1 was treated as control. In group T_2, T_3, T_4 and T_5, 25%, 50%, 75% and 100% of CP supplied through concentrate mixture was replaced by HMF, respectively. Whereas in group T_6, T_7, T_8 and T_9, 25%, 50%, 75% and 100% of CP supplied through concentrate mixture was replaced by HMF with probiotic, respectively.

Result: There was highly significant (P<0.01) effect of treatments *i.e.* feeding of HMF with and without supplementation of probiotic as well as period (age of calves) on periodical body weight and ADG. There was significantly higher mean periodical body weight (kg) and ADG (g/d) in calves fed HMF and probiotic than control. The highest overall mean body weight and ADG was observed in group T_8, followed by T_4 and lowest in control group. Overall mean body measurements *viz*. BH, BL and BG was highest in group T_8 and lowest in group T_1 but the variation was statistically non-significant for BG. Highly significant (P<0.01) effect of treatments and period were observed on FCR also. Lowest FCR was recorded in group T_8, followed by T_4 and highest FCR was recorded in control group. It was concluded that better growth performance was evoked in Gir cattle calves fed 75% CP of concentrate mixture replaced by hydroponics maize green fodder with probiotic.

Key words: Gir calves, Growth performance, Hydroponics maize fodder, Probiotic.

INTRODUCTION

Technology advancement has introduced hydroponics technology for green fodder production. In the prevailing dairy farming system, where quality and quantity of grazing is continuously decreasing, the hydroponics grown green fodder could be a novel way of feeding dairy animals. Hydroponics technology may become an alternative for the green fodder production (Sneath and McIntosh, 2003; Naik *et al*., 2012). Hydroponics technology is coming up as an alternative to grow fodder due to various constraints in the production of green fodder conventionally (Ansari *et al*., 2019). A lot of advantages have been associated with hydroponically grown green fodder as it is a viable alternative technology for the farmers having no grazing lands or water scarcity. It can be produced as per the daily requirement and there are no post-harvest losses. Round the year consistent high quality green fodder can be obtained. This technology may be especially important in regions where forage production is limited (Afzalinia and Karimi, 2020).

Use of natural feed additives in dairy cattle ration has importance for improvement in growth and production. There is strong need for natural feed additives acceptable for consumers interested in organic food.

Limited research has been conducted on growth performance of dairy calves fed hydroponics maize fodder along with probiotics. The present study was conducted to find out the effect of feeding of hydroponics maize fodder with and without supplementation of probiotic (*Saccharomyces cerevisiae*) on growth performance in Gir calves.

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How to cite this article: Joshi, M., Sharma, S.K. and Vaishnava, C.S. (2024). Effect of Concurrent Feeding of Hydroponics Maize Fodder and Probiotic (*Saccharomyces cerevisiae*) on Growth Performance in Gir Calves. Asian Journal of Dairy and Food Research. 43(3): 566-571. doi: 10.18805/ajdfr.DR-1716.

Submitted: 12-05-2021 **Accepted:** 03-08-2021 **Online:** 20-08-2021

MATERIALS AND METHODS

Experimental feed

The production of hydroponics maize was done in a

hydroponics chamber of Ayurvet Progreen Machine. Clean maize seeds were soaked with tap water in gunny bags for 24 hours and thereafter were distributed in trays @ 2 kg per tray in 1.5-2 cm layer thickness. Harvesting of hydroponics fodder was done on day 8th after planting.

Experimental animals and design

Total 36 male Gir calves of almost same age group were selected randomly and distributed equally by completely randomized block design in nine groups. The calves were of almost same body weight and uniform conformation. The animals were given measured quantity of experimental feed and *ad lib* water.

Feeding regimens

All the animals were offered basal feed ad lib. Calves in group T_1 were treated as control and were fed basal feed and concentrate mixture as per requirement. For calves in T_2, T_3, T_4 and T_5 groups, 25%, 50%, 75% and 100% of CP supplied through concentrate mixture was replaced by hydroponics maize fodder, respectively, whereas in T_6, T_7, T_8 and T_9 groups, 25% 50%, 75% and 100% of CP supplied through concentrate mixture was replaced by hydroponics maize fodder alongwith probiotic, respectively.

Experiment

A feeding trial of 120 days was conducted on total 36 Gir calves. Body weight and body measurements h were recorded at fortnightly intervals.

Statistical procedures

The data obtained in the experiment were analyzed using statistical procedures as described by Snedecor and Cochran (1994) and significance of mean differences were tested by Duncan's new multiple range test (DNMRT) as modified by Kramer (1957).

RESULTS AND DISCUSSION

Periodical body weight change and average daily gain

Mean initial body weight (0 day) of calves in different treatment groups were almost similar whereas variations were observed in mean body weight of calves at the end of the experiment (120 days). The overall mean periodical body weight (kg) ranged from 114.21 to 124.01 in different treatment groups (Table 1). The statistical analysis of data showed highly significant (P<0.01) effect due to treatments and period on periodical body weight (Table 6).

Significant variations were observed among the treatments with the highest mean periodical body weight in group T_8, followed by T_4, T_5, T_7, T_9, T_3, T_6, T_2 and lowest in T_1 *i.e.* control (Table 1).

Significantly lower mean periodical body weight in control group than rest of the treatment groups indicated positive effect of hydroponics maize fodder on growth. Comparison of mean periodical body weight of group T_2 to T_5 with corresponding T_6 to T_9 group showed higher mean body weights in later treatment groups indicating positive effect of probiotics.

Across periods (0 d to 120 d), a significant increase in overall mean body weight from 97.74 (0 d) to 141.89 kg in 120 days could be attributed to the growing phase of calves as well as provision of adequate balanced nutrition to the animals.

The overall average daily gain (g/d) of calves in different treatment groups ranged in between 280.00 - 426.99 (Table 2). There was highly significant (P<0.01) effect of feeding hydroponics maize fodder and probiotic on average daily gain (Table 6).

Significant variations in average daily gain (g/d) among different treatment groups were observed. Feeding of hydroponics maize fodder with and without supplementation of probiotic resulted in significantly higher average daily gain in various treatment groups than control group (Table 2). Average daily gain (g/d) was found to be highest in group T_8 and lowest in T_1 *i.e.* control.

It was revealed that mean periodical body weight and average daily gain was highest in calves of group T_8. There was significantly higher mean periodical body weight (kg) and average daily gain (g/d) in calves fed hydroponic maize fodder and probiotic. Findings of present investigation are in agreement with that of Muela *et al*. (2005);

Table 1: Periodical body weight change (kg) in calves at fortnight intervals in different treatment groups.

Treatment / Period (Days)	T_1	T_2	T_3	T_4	T_5	T_6	T_7	T_8	T_9	Mean
0	97.30	97.62	97.59	97.70	97.80	97.85	97.95	97.98	97.95	97.74^{h}
15	101.60	102.94	103.40	104.20	103.62	103.24	103.79	104.53	103.94	103.47^{g}
30	106.00	108.27	109.22	111.70	109.61	109.56	109.03	110.98	109.03	109.27^{f}
45	110.11	112.11	114.85	117.12	115.55	114.95	116.15	117.54	114.84	114.80^{e}
60	114.36	117.23	120.02	123.55	120.99	117.84	122.95	124.12	120.25	120.15^{e}
75	118.54	122.31	126.05	129.92	127.33	123.34	126.65	130.90	126.60	125.74^{d}
90	122.58	127.64	131.63	136.30	133.17	128.79	132.69	136.80	133.79	131.49^{c}
105	126.52	132.23	136.77	142.40	138.77	134.41	137.69	144.01	139.85	136.96^{b}
120	130.89	136.81	141.58	148.51	144.38	137.94	143.80	149.21	143.93	141.89^{a}
Mean	114.21^{f}	117.46^{e}	120.12^{c}	123.44^{a}	121.25^{b}	118.66^{d}	121.19^{b}	124.01^{a}	121.13^{b}	120.16

Rows and columns with different superscript differ significantly; SEm ± 1.767; C.D. at 0.05= NS.

Verma *et al*. (2015) and Rajkumar *et al*. (2018) in cattle. Further, Abdalla *et al*. (2013); Ghazanfar *et al*. (2015); Yirga (2015); and Hassan *et al*. (2016) reported improved ADG in calves fed *Saccharomyces cerevisiae*.

Periodical body measurements

The overall mean body height in different treatment groups ranged 105.90 - 108.20 cm. The statistical analysis of data revealed highly significant (P<0.01) effect of treatments as well as period on the body height in calves (Table 6). Across the periods, a significant steady increase in body height was observed which could be attributed to the growing phase of calves and provision of adequate balanced nutrition. The comparison of means by DNMRT indicated significant variations in mean body height in different treatment groups. Mean body height was

Table 2: Average daily gain (g/d) at fortnight intervals in different treatment groups.

Period (Days) \ Treatment	T_1	T_2	T_3	T_4	T_5	T_6	T_7	T_8	T_9	Mean
15	287.00	354.66	387.33	433.33	388.00	359.33	389.33	436.65	399.33	381.66^{a}
30	293.66	355.33	388.00	500.00	399.33	332.66	349.33	430.60	339.33	376.47^{b}
45	274.33	266.66	344.66	361.33	399.00	333.33	408.00	437.33	387.33	356.88^{c}
60	283.00	341.33	402.00	428.66	362.66	352.66	393.33	438.66	360.66	373.66^{b}
75	279.00	338.66	371.33	424.66	422.66	377.33	373.33	418.66	423.33	381.00^{a}
90	269.00	355.33	372.00	425.33	389.33	312.66	370.00	426.66	479.33	377.74^{ab}
105	263.00	306.00	342.66	406.66	373.33	281.33	366.00	414.00	404.00	350.78^{cd}
120	291.01	305.33	320.66	407.33	374.00	278.00	340.66	413.33	408.00	348.70^{d}
Mean	280.00^{h}	327.91^{gh}	366.08^{e}	423.41^{ab}	388.54^{d}	328.41^{g}	373.75^{f}	426.99^{a}	400.16^{c}	372.17

Rows and columns with different superscript differ significantly; SEm ± 5.496; C.D. at 0.05 =15.3194.

Table 3: Periodical body height change (cm) in calves at fortnight intervals in different treatment groups.

Period (Days) \ Treatment	T_1	T_2	T_3	T_4	T_5	T_6	T_7	T_8	T_9	Mean
0	101.03	100.38	101.48	101.53	101.61	101.69	101.96	101.74	101.34	101.41^{h}
15	102.45	101.60	102.60	101.80	101.23	101.88	103.11	102.65	102.36	102.19^{h}
30	103.04	104.68	103.11	104.23	104.33	103.56	104.23	104.34	103.86	103.93^{g}
45	104.14	106.14	105.23	106.79	105.51	106.65	106.18	105.89	105.25	105.75^{f}
60	105.23	107.25	108.56	107.24	108.99	107.23	108.21	108.43	107.24	107.60^{e}
75	106.68	109.11	109.65	109.99	110.10	109.12	109.65	110.90	109.90	109.46^{d}
90	107.13	110.61	111.02	111.45	111.53	110.91	110.31	111.44	112.36	110.75^{c}
105	109.14	111.76	112.93	113.76	112.87	112.43	112.90	113.43	113.67	112.54^{b}
120	114.30	114.16	114.34	114.89	114.20	114.66	114.76	114.99	114.97	114.59^{a}
Mean	105.90b	107.30a	107.66a	107.96a	107.82a	107.57a	107.92a	108.20a	107.88a	107.58

Rows and columns with different superscript differ significantly; SEm ± 1.004; C.D. at 0.05 = NS.

Table 4: Periodical body length change (cm) in calves at fortnight intervals in different treatment groups.

Period (Days) \ Treatment	T_1	T_2	T_3	T_4	T_5	T_6	T_7	T_8	T_9	Mean
0	53.29	53.66	53.47	53.59	53.63	53.67	53.66	53.68	53.63	53.58^{i}
15	55.24	55.44	55.57	55.79	55.78	55.59	55.75	55.99	55.82	55.66^{h}
30	58.45	58.63	58.34	58.98	58.34	58.19	57.95	58.41	58.38	58.41^{g}
45	59.57	59.11	59.65	59.32	58.89	59.34	59.45	59.67	59.02	59.34^{f}
60	61.22	61.45	61.56	61.86	62.11	62.65	61.98	62.52	62.82	62.02^{e}
75	62.75	62.54	62.84	62.87	63.21	63.45	63.05	63.91	63.11	63.08^{d}
90	63.11	63.56	63.26	63.56	63.88	64.01	65.11	65.82	64.44	64.08^{c}
105	66.54	66.89	67.23	67.98	67.45	66.56	66.63	66.98	67.08	67.04^{b}
120	68.58	68.98	68.90	68.99	68.56	68.22	68.71	68.99	68.03	68.66^{a}
Mean	60.97^{b}	61.14^{b}	61.20^{b}	61.43^{b}	61.31^{b}	61.29^{b}	61.36^{b}	61.77^{a}	61.37^{b}	61.31

Rows and columns with different superscript differ significantly; SEm ± 0.431; C.D. at 0.05 = NS.

observed highest in group T_8 and lowest in group T_1 *i.e.* control (Table 3).

The overall mean body length in different treatment groups ranged 60.97 - 61.77 cm. The body length of calves was found to be increased in almost uniform pattern with the period. The trend of increase in body length in calves with the advancement of age was similar to that of body height. The statistical analysis of data revealed significant (P<0.05) effect of treatments on body length but the effect of period was found to be highly significant (P<0.01) on body length (Table 6). Comparison of means across the periods revealed sequential increase in body length from 0 to 120 days which could be attributed to the advancement of age and supported by adequate balanced nutrition. The comparison of means by DNMRT indicated that there was significant variation in different treatment groups comprising of hydroponics maize fodder with and without supplementation of probiotic (Table 4). The highest body length was observed in group T_8 and lowest in group T_1 *i.e.* control.

The overall mean values of body girth in calves different treatment ranged 114.25-114.91 cm (Table 5). The statistical analysis of data revealed non-significant (NS) difference in mean body girth (cm) in calves in different treatment groups but there was highly significant (P<0.01) effect of period on body girth in calves (Table 6). Comparison of means across

Table 5: Periodical body girth change (cm) in calves at fortnight intervals in different treatment groups.

Period (Days) \ Treatment	T_1	T_2	T_3	T_4	T_5	T_6	T_7	T_8	T_9	Mean
0	99.01	99.14	99.26	99.45	99.53	99.33	99.45	99.67	99.62	99.38^{i}
15	106.22	106.45	106.83	105.54	106.93	107.01	106.56	106.89	105.43	106.43^{h}
30	109.45	110.12	109.43	111.32	109.91	110.23	111.93	111.22	110.45	110.45^{g}
45	112.65	113.33	113.67	114.02	112.84	111.82	113.51	114.41	114.02	113.36^{f}
60	115.21	115.67	115.43	116.11	116.43	115.08	114.25	116.24	115.92	115.59^{e}
75	118.84	117.54	118.75	117.23	118.61	119.32	118.42	117.84	116.67	118.14^{d}
90	120.32	121.09	120.89	121.13	120.88	121.19	120.34	121.26	121.89	121.00^{c}
105	122.13	122.76	122.45	123.54	123.23	122.91	123.03	122.03	123.73	122.87^{b}
120	124.46	124.88	124.90	125.22	124.11	124.32	124.54	124.65	124.98	124.67^{a}
Mean	114.25	114.55	114.62	114.84	114.72	114.58	114.67	114.91	114.75	114.65

Rows and columns with different superscript differ significantly; SEm ± 1.618; C.D. at 0.05 = NS.

Table 6: ANOVA of periodical body weight change (kg), average daily gain (g/d) and periodical body measurements.

Attribute	Source of variance	d.f.	mss	F Value	Level of sig.
Periodical body weight change (kg)	Treatment	8	333.0	26.656	**
	Period	8	8291.4	663.626	**
	TxP	64	17.0	1.363	NS
	Error	243	12.5		
Average daily gain (g/d)	Treatment	8	75840.423	627.717	**
	Period	7	6921.042	57.284	**
	TxP	56	2845.287	23.550	**
	Error	216	120.820		
		Periodical body measurements			
Periodical body height change (cm)	Treatment	8	16.6	4.122	**
	Period	8	769.5	190.847	**
	TxP	64	2.2	0.545	NS
	Error	243	4.0		
Periodical body length change (cm)	Treatment	8	1.8	2.375	*
	Period	8	909.4	1224.152	**
	TxP	64	0.7	0.951	NS
	Error	243	0.7		
Periodical body girth change (cm)	Treatment	8	1.3	0.125	NS
	Period	8	2435.7	232.554	**
	TxP	64	1.7	0.162	NS
	Error	243	10.5		

** = Significant at 1% (p<0.01); * = Significant at 5% (p<0.05); NS= Non Significant.

Table 7: Feed conversion ratio (FCR) in calves at fortnight intervals in different treatment groups.

Period (Days) \ Treatment	T_1	T_2	T_3	T_4	T_5	T_6	T_7	T_8	T_9	Mean
15	9.61	8.67	7.87	6.96	7.68	9.16	7.91	6.97	7.55	8.04[a]
30	9.92	8.68	7.88	6.05	7.51	9.37	8.84	7.08	8.94	8.25[b]
45	11.10	12.11	9.29	8.79	7.98	9.80	7.93	7.34	8.29	9.18[c]
60	11.54	10.14	8.55	7.96	9.32	9.92	8.82	7.84	9.47	9.28[c]
75	12.22	10.84	9.84	8.54	8.50	9.82	9.83	8.74	8.57	9.66[d]
90	13.31	10.94	10.38	9.01	9.49	12.55	10.52	9.07	7.73	10.33[e]
105	14.59	11.90	12.42	10.40	11.24	15.35	11.72	10.29	10.44	12.04[f]
120	13.97	14.72	13.93	10.88	11.76	16.36	13.20	10.78	10.89	12.94[g]
Mean	12.03[g]	11.00[e]	10.02[d]	8.57[a]	9.19[b]	11.54[f]	9.85[c]	8.51[a]	8.98[b]	8.69

Rows and columns with different superscript differ significantly; SEm ± 0.150; C.D. at 0.05 =0.4172.

Table 8: ANOVA of feed conversion ratio (FCR).

Attribute	Source of variance	d.f.	mss	F Value	Level of sig.
FCR	Treatment	8	53.831	600.681	**
	Period	7	108.572	1211.510	**
	TxP	56	2.701	30.142	**
	Error	216	0.090		

** = Significant at 1% (p<0.01); * = Significant at 5% (p<0.05); NS= Non Significant.

the periods revealed significant uniform increase in body girth from 0 to 120 days of experimental period in all the treatment groups (similar to that of body height and length) which could be attributed to the advancement of age and adequate nutrition. The highest body girth was observed in group T_8 and lowest in group T_1 *i.e.* control but the differences were statistically found to be non-significant.

It is revealed that feeding of hydroponics maize fodder and probiotic had positive effect on the morphometric or structural growth in Gir calves. Lesmeister *et al.* (2004) and Heinrich (2004) also reported that inclusion of yeast in feed of calves increased structural growth. Due to scanty work, no any reference was found regarding effect of hydroponics maize fodder on body measurements in calves. However, hydroponics maize fodder and probiotic probably had higher bioavailability of nutrients for morphometric or structural growth of the calves in this experiment.

Feed conversion ratio (FCR)

Overall mean values of FCR ranged from 8.51 to 12.03 in different treatment groups. The overall average FCR values across the period increased from 8.04 (15 d) to 12.94 (120 d) indicating better feed conversion efficiency in earlier stage as compared to latter stage of growth in calves (Table 7). The statistical analysis of data revealed highly significant (P<0.01) effect of treatments as well as period on FCR (Table 8).

The comparison of means of various treatment groups revealed statistically significant variations among the treatment groups (Table 7). Lowest FCR was recorded in group T_8, followed by T_4, T_9, T_5, T_7, T_3, T_2, T_6 and T_1. Highest FCR was observed in group T_1. The improved FCR in all the treatment groups indicated better utilization and absorption of nutrients than control group.

The best feed conversion efficiency was evoked in calves of group T_8. Thus, better feed conversion was observed in calves fed hydroponics maize fodder with probiotic. Similar findings were reported by Naik *et al.* (2014); and Rajkumar *et al.* (2018). Yirga (2015) in cattle; and Reena Kamal *et al.* (2013) in kids reported better feed conversion fficiency with yeast supplementation.

CONCLUSION

It was concluded that there was highly significant (P<0.01) effect of treatments and period on periodical body weight, ADG and FCR. The highest overall mean body weight and ADG was observed in group T_8. It indicated positive effect of hydroponics maize fodder and probiotic on growth performance in Gir calves. The best feed conversion efficiency was evoked in calves of group T_8.

Conflict of interest

All authors declare that they have no conflict of interest.

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