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Research Paper

EFFECT OF HYDROPONIC MAIZE FODDER WITH REPLACEMENT OF CO4 GRASS ON MILK PRODUCTION IN CROSSBRED DAIRY CATTLE

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This experiment was aimed to study the effect of hydroponic maize fodder with replacement of CO4 grass (50%, 100%) on milk production in cross bred dairy cattle. Palatability trial for a period of 7 days was carried out to assess the acceptance and intake of hydroponic maize fodder by the cattle. The maximum intake of hydroponic yellow maize fodder was found to be 15+0.42 kg per animal. Based on the palatability trial and proximate analysis of hydroponic maize fodder, a feeding trial was formulated on as fed basis. 12 cross bred cattle at 2nd stage of 4th lactation were divided into 3 groups', viz., treatment 1 (control), treatment 2 (50% replacement of CO4 grass) and treatment 3 (100% replacement of CO4 grass). Duration of the study was 30 days. Production parameters such as milk yield and quality (fat, SNF and protein) before and during trial were studied. After analysis of collected data it was found that all the three groups are not significantly different in terms of milk yield before and during the trial. Economics of feeding was also analyzed for all the three groups. The feed cost per kg of milk production was lower in 100% replacement of CO4 grass group (Rs. 14.6+0.51) than other groups as there is a non significant increase in milk yield was noticed in this group than the CO4 grass fed group. The income through sale of milk/animal and net profit per animal was significantly higher in 100% replacement of CO4 grass group (Rs. 493.6+0.46, Rs. 313.0+0.28) than the other groups.

Keywords: Hydroponic maize fodder, CO4 grass, Milk yield, Economics

INTRODUCTION

A major concern in developing sustainable dairy farming is to make available and feed the animals with green fodder economically (Naik *et al*., 2015). The major constraints in production of green fodder by dairy farmers are decreasing land

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holding size, high cost of land, scarcity of water or saline water, more labour requirement for cultivation (sowing, earthing up, weeding, harvesting, etc.), requirement of manure and fertilizer, more growth time, non-availability of same quality green fodder round the year, high fencing cost to protect from wild animals, influences of natural calamities, etc. (Naik *et al*., 2015). Hydroponics is now emerging as an alternative technology to grow fodder for farm animals (Naik *et al.,* 2011; Naik 2012; Naik *et al.,* 2013a; Naik *et al*., 2013b; Naik and Singh, 2013; Naik, 2014; Naik and Singh, 2014; and Naik *et al*., 2015).

MATERIALS AND METHODS

Production of Hydroponic Fodders

Hydroponic maize fodder was produced in environmentally controlled hydroponic green fodder machine of 1 ton capacity purchased under NADP scheme 2014-15. Good quality seeds with less than 12% moisture were selected and weighed. Seeds were washed in tap water by stirring with wooden stick manually to remove chaffs and dirts. The seeds were then soaked in tap water for 20 hours. Then water was drained and the seeds were kept in gunny bags for 24 hours for germination. After germination, seeds were weighed and placed onto different trays and kept on the sprout section of hydroponic green fodder machine. Each tray in the sprout section is provided with two drippers and one sprinkler which sprinkle water in every 3 hours for about 4 minutes. The trays were shifted to next rack daily. On the 5th day the tray enters the growth cycle in which each tray is supplied with two sprinklers. After 8 days of total growth period in the machine the fodders were taken out, weighed and then fed to livestock. Proximate analysis of hydroponic yellow maize was done as per AOAC (2000).

Palatability Trial

Palatability trial for a period of 7 days was carried out to assess the acceptance and intake of hydroponic maize fodder by the cattle. Measured quantity of hydroponic maize fodder was fed and the left over in the next morning were measured to estimate the actual intake of hydroponic maize fodder.

Feeding Trial

After analysing the palatability and maximum intake of hydroponic maize fodder; proximate of hydroponic yellow maize fodder and CO4 grass (Table 2), feeding trial was formulated on as fed basis as given in Table 1.

Experimental Design

12 cross bred cattle at 2nd stage of 4th lactation were divided into 3 groups', viz., treatment 1 (control), treatment 2 (50% replacement of CO4 grass) and treatment 3 (100% replacement of CO4 grass) each having 4 cows.

Animal Housing and Feeding Management

Cows were reared by intensive system in a well ventilated clean shed with proper spacing for individual cows. All the cows in the three groups were fed similar quantity (6 kg) of concentrate mixture (yellow maize 22%, cumbu 12%, wheat bran 25%, de oiled rice bran 20%, groundnut oil cake 10%, soya bean meal 8%, mineral mixture 2% and salt 1%) having 14.1% crude protein and 72.11% TDN; ad libitum dry fodder, i.e., paddy straw. All the cows were provided with ad libitum clean drinking water throughout the day. The study was conducted for a period of 30 days. Cows were milked twice a day and the milk yield was

Table 1: Feeding Schedule (on as Fed Basis)

Type of Fodder	Treatment 1	Treatment 2	Treatment 3
	Control	50% Replacement of CO4 Grass	100% Replacement of CO4 Grass
CO4 grass	20 kg	10 kg	0
Hydroponic maize fodder	0	5.8 kg	11.6 kg

Table 2: Nutritional Composition of Fodders

S. No.	Fodder	Moisture %	% Dry Matter Basis				
			CP	CF	EE	TA	NFE
1	CO4 grass	75.88	7.73	27.71	2.25	13.99	48.32
2	Hydroponic yellow maize	76.75	10.55	5.51	4.62	1.8	77.52

quantified daily throughout the study period. Milk samples were collected from each cow before and during trial in all the three groups and the milk quality parameters such as fat, SNF and protein content were estimated.

Recording and Statistical Analysis of Data

Cows were milked twice a day and the milk yield was quantified daily throughout the study period. Milk samples were collected from each cow before and during trial in all the three groups and the milk quality parameters such as fat, SNF and protein content were estimated. Data were recorded periodically and one-way ANOVA was computed using Graphad prism software.

RESULTS AND DISCUSSION

Nutritional Composition of Fodders

The nutritional composition of fodders under study was given in Table 2.

Naik *et al*. (2014a) reported the nutritional composition of hydroponic maize fodder on dry matter basis as follows 13.30% crude protein, 3.27% Ether extract, 6.37% Crude fiber, 75.32% Nitrogen free extract 1.75 Total ash, which is slightly different from the composition of hydroponic maize fodder under study. Hydroponic yellow maize fodder was found to have higher CP, EE and NFE; and lower CF, TA than conventional green fodder (CO4 grass). Naik *et al.* (2012b) also reported higher CP, EE and NFE; and lower CF and TA percentage in hydroponics maize fodder than the conventional maize fodder. The increase in CP content may be attributed to the loss in DM, particularly carbohydrates, through respiration during germination and thus longer sprouting time is responsible for greater losses in DM and increase in protein content. Besides, the absorption of nitrates facilitates the metabolism of nitrogenous compounds and thus increases the CP levels (Naik *et al.,* 2015). The nutrient contents of hydroponics fodder are superior to certain common non-leguminous fodders but comparable to leguminous fodders (Pandey and Pathak 1991; and Naik *et al*., 2012) in terms of available OM, CP, EE and NFE content.

Palatability Trial

The maximum intake of hydroponic yellow maize fodder was found to be 15±0.26 kg per animal per day. Naik *et al*. (2014) also has conducted

Table 3: Production Parameters

Attributes	Treatment 1	Treatment 2	Treatment 3
No. of cattle per treatment	4	4	4
Average milk yield prior treatment (kg)	9.14±0.54^{a}	9.90±0.70^{a}	11.18±0.60^{a}
Average milk yield during treatment (kg)	8.62±0.54^{a}	11.11±0.52^{ab}	12.34±0.70^{b}
Average fat percentage in milk prior treatment (%)	4.43±0.38^{a}	4.40±0.40^{a}	4.23±0.47^{a}
Average fat percentage in milk during treatment (%)	4.43±0.24^{a}	4.43±0.30^{a}	4.09±0.22^{a}
Average SNF in milk prior treatment (%)	8.42±0.31^{a}	8.50±0.35^{a}	8.62±0.17^{a}
Average SNF in milk during treatment (%)	8.37±0.18^{a}	8.47±0.17^{a}	8.35±0.12^{a}
Average protein in milk prior treatment (%)	4.91±0.45^{a}	4.25±0.48^{a}	4.87±0.49^{a}
Average protein in milk during treatment (%)	4.77±0.22^{a}	4.72±0.23^{a}	4.80±0.21^{a}

Note: Means with similar superscript in the same row do not differ significantly (P > 0.05); Means with different superscript in the same row differ significantly (P < 0.05).

Figure: Effect of Hydroponic Maize Fodder with 50% and 100% Replacement of CO_4 Grass on the Milk Yield and Quality in Dairy Cattle

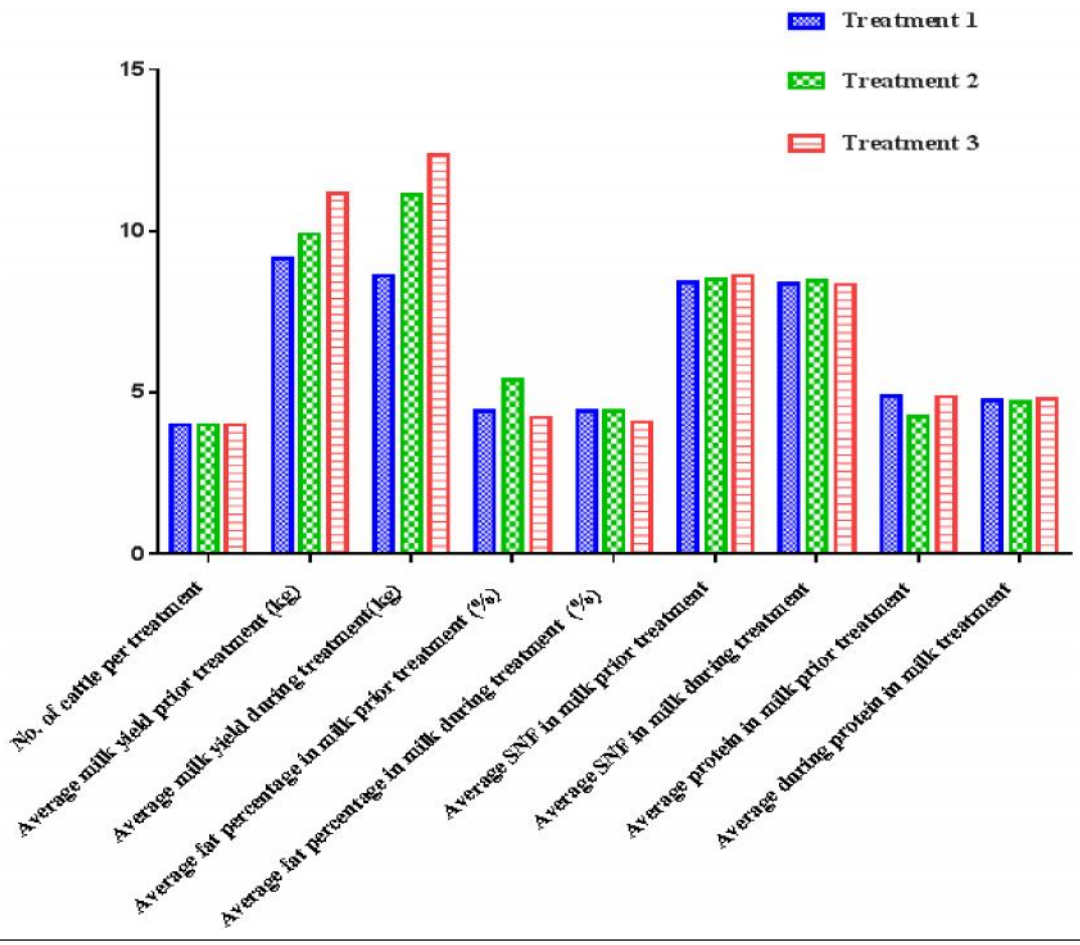

Table 4: Production Parameters in the Same Group Before and During Treatment

Attributes	Prior to Treatment	During Treatment
Treatment 1		
Average milk yield (kg)	9.14±0.54[a]	8.62±0.54[a]
Average fat percentage in milk (%)	4.43±0.38[a]	4.43±0.24[a]
Average SNF in milk (%)	8.42 ±0.31[a]	8.37±0.18[a]
Average protein in milk (%)	4.91± 0.4[a]	4.72±0.23[a]
Treatment 2		
Average milk yield (kg)	9.90±0.70[a]	11.11±0.52[a]
Average fat percentage in milk (%)	4.40 ±0.40[a]	4.43±0.30[a]
Average SNF in milk (%)	8.50±0.35[a]	8.47±0.17[a]
Average protein in milk (%)	4.25±0.48[a]	4.72±0.23[a]
Treatment 3		
Average milk yield (kg)	11.18±0.60[a]	12.34±0.70[a]
Average fat percentage in milk (%)	4.23±0.47[a]	4.09±0.22[a]
Average SNF in milk (%)	8.62±0.17[a]	8.35±0.12[a]
Average protein in milk (%)	4.87±0.49[a]	4.80 ±0.21[a]

Note: Means bearing similar superscript in the same row do not differ significantly (P > 0.05).

trial in dairy cows by feeding 15 kg of hydroponic maize fodder.

Feeding Trial

The various production parameters studied were given in Table 3 and Figure 1. There is no significant difference was noticed between the groups.

From the table it is evident that there is no significant difference among the groups, i.e., conventional fodder fed animals and hydroponic fodder fed animals had uniform milk yield and quality before start of trial. Uniform milk yield and quality was also reported during the trial period among the groups which implies hydroponic maize fodder can be used as an alternate to green fodder at 50% level or 100% level in the diet of cross bred dairy cattle according to the availability without affecting the milk yield and quality. However non significant increase in milk yield was noticed in hydroponic fodder fed groups such as treatment 1 and treatment 2 which implies that there is a probability of increase in milk yield if the hydroponic fodder was fed in higher quantities per animal. The milk yield and quality before and after treatment in the same group was compared in Table 4.

From the table it is evident that the milk yield and quality in terms of fat, SNF and protein was similar before and during the trial among all the treatment groups. This implies that there was no change in the milk yield and quality in the cross bred dairy cows by the replacement of CO4 grass with hydroponic maize fodder during the study period. Hence hydroponic yellow maize fodder can be used to maintain productivity in dairy cows

Table 5: Economics of Feeding

S. No.	Attributes	Treatment 1	Treatment 2	Treatment 3
1	Cost of feeding/day/animal (Rs.)	180 ± 0.32^{a}	180.3 ± 0.25^{a}	180.6 ± 0.19^{a}
2	Feed cost/kg milk production/day (Rs.)	20.88 ± 0.42^{c}	16.23 ± 0.47^{b}	14.6 ± 0.51^{a}
3	Income through sale of milk/animal/day (@ Rs. 40/kg) (Rs.)	344.8 ± 0.36^{a}	444.4 ± 0.54^{b}	493.6 ± 0.46^{c}
4	Net profit/animal/day (Rs.)	164.8 ± 0.39^{a}	264.1 ± 0.51^{b}	313.0 ± 0.28^{c}

Note: Means with different superscript in the same row differ significantly ($P < 0.01$).

during fodder shortage or non-availability of green fodder. 13.7% increase in the milk yield due to feeding of hydroponics maize fodder was observed by Naik *et al.* (2014a) and an increase of 7.8% in milk production was observed in cows fed ration containing hydroponics barley fodder by Reddy *et al.* (1988) which may be due to the higher DCP and TDN content (Naik *et al.*, 2014a).

Economics of Feeding

The economics of feeding for the treatments groups was given in Table 5.

Cost of production of one kg of hydroponic yellow maize fodder was Rs. 3.20. However Naik *et al.* (2014a) reported that the cost of hydroponic maize fodder as Rs. 4.00/kg. The cost of feeding/ day was almost similar in all the three groups ($P > 0.05$). However the feed cost per kg of milk production was lower in 100% replacement of CO4 grass group than other groups as there is a non significant increase in milk yield was noticed in this group that the CO4 grass fed group. The income through sale of milk/animal and net profit per animal was significantly higher in 100% replacement of CO4 grass group than other groups.Thus feeding hydroponic fodder d the net profit per animal. Reddy *et al.* (1988) also reported that the cost of feed per kg milk production increased by 20% on the ration containing artificially grown fodder. Feeding of hydroponics maize fodder increased the digestibility of nutrients, milk production and net profit in lactating cows (Naik *et al*., 2015).

CONCLUSION

50% and 100% replacement of conventional green fodder, i.e., CO4 grass with hydroponic yellow maize fodder in the diet of cross bred dairy cattle have shown similar milk yield and quality as that of conventional green fodder. There is only slight deviation in the cost of conventional green fodder when compared to hydroponic yellow maize fodder. Thus hydroponic yellow maize fodder can be used as an alternative to conventional green fodder, i.e., CO4 grass to sustain the productivity of dairy cattle. Hydroponic fodder production method is a boon to landless farmers for better productivity in their dairy cattle.

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