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Effect of Feeding Hydroponic Maize Fodder With and Without Supplementation of Probiotic (*Saccharomysis Cerevisiae*) on Nutrient Utilization in Calves

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ABSTRACT

Hydroponics technology may become an alternative not only for the green fodder but also some part of concentrate in farm animals. A feeding trial of 120 days was conducted on total 36 male Gir calves. All the animals were offered basal feed *ad lib.* In addition, calves in group T1 were treated as control and were fed concentrate mixture as per requirement. For calves in T2, T3, T4 and T5 groups, 25%, 50%, 75% and 100% of crude protein supplied through concentrate mixture was replaced by hydroponics maize green fodder, respectively. Whereas in T6, T7, T8, T9 groups, 25% 50%, 75% and 100% of crude protein supplied through concentrate mixture was replaced by hydroponics maize green fodder alongwith probiotics (*Saccharomyces cerevisiae*), respectively. The results of statistical analysis of data revealed highly significant ($P<0.01$) effect of treatment i.e., feeding of hydroponics maize fodder at different levels with and without probiotic (*Saccharomyces cerevisiae*) on crude protein, crude fibre, nitrogen free extract and acid detergent fibre digestibility in calves. There was non-significant effect of feeding hydroponics maize fodder at different levels with and without probiotic on ether extract, neutral detergent fibre and hemicelluloses.

KEY WORDS: Calves, Digestibility, Hydroponic fodder, Nutrient Utilization, Probiotics

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INTRODUCTION

Calf rearing is an important component of a dairy farm to sustain the production (Sharma and Joshi,2020). Feeding and nutrition are the most important aspects for the sustainability of the growth performance in calves. Optimum nutrient utilization is essential requirement for good health and growth performance. The pasture grasses, forage, agriculture by products and cereal crop residues are major feed resources for dairy animals in India. Lack of green fodder in the ration will adversely affect the growth, milk yield and reproductive performance of dairy animals. Green fodder and concentrate are the need for optimum health, growth, production and reproductive performance in dairy animals. For sustainable dairy farming, quality green fodder should be fed regularly to dairy animals (Naik et al.,2012).

Hydroponics is the newer technology for green fodder production. Hydroponics maize fodder has high quality that is rich in protein, fibres, vitamins and minerals with health beneficial effects for calves and other dairy animals (Boue et al.,2003; Chethan et al., 2021a,b; Chethan et al., 2022 a,b). Study on hydroponic grain sprouts have indicated their limited utility as green fodder but they provide nutritious green feed in terms of amino acids and micronutrients (Chethan et al., 2021) of Similarly, probiotics are also being fed to dairy calves(Dar et al.,2019). Supplementation of Hydroponics fodder with probiotics improves the health status and their productive efficiency. There is need to evaluate the effect of feeding hydroponics maize and probiotics on nutrient utilization in calves therefore the present investigation was conducted to study the effect of feeding hydroponic maize fodder with and without supplementation of probiotics (*Saccharomysis cerevisiae*) on nutrient utilization in Calves

MATERIALS AND METHODS

The experiment was conducted at College of Veterinary and Animal Science, Rajasthan University of Veterinary and Animal Sciences, Navania, Udaipur, Rajasthan, India.Total 36 male Gir calves of almost same age group (6-12 months) were selected randomly and distributed in nine groups. Each group had four calves. The calves were of almost same body weight and uniform conformation. Initial average body weight of calves in different treatment groups ranged between 97.3 to 97.9 kg. The animals of experimental groups were housed in wellventilated, hygienic and protected sheds. The animals were stall fed throughout the experimental period. All the animals were provided fresh and cleandrinking water *ad lib*.

Male calves were distributed by completely randomized block design in to nine groups of four animals in each group and subjected to various treatment feeds.All the animals were offered basal feed ad lib. Daily allowance of concentrate and / or hydroponics maize fodder and roughage (wheat straw *ad lib*.) were offered to meet their nutrient requirements as per feeding standards (ICAR, 2013).Calves in group T1 were treated as control and were fed basal feed and concentrate mixture as per requirement. For calves in T2, T3, T4 and T5 groups, 25%, 50%, 75% and 100% of crude protein supplied through concentrate mixture was replaced by hydroponics maize green fodder, respectively. Whereas in T6, T7, T8, T9 groups, 25% 50%, 75% and 100% of crude protein supplied through concentrate mixture was replaced by hydroponics maize green fodder alongwith probiotics (*Saccharomyces cerevisiae*), respectively. Probiotics was fed @ 5 gm daily(*Saccharomyces cerevisiae* 1500 million CFU). Dry matter intake was calculated at fortnight intervals as g/d, kg/100kg b. wt. and g/kg $W^{0.75}$ in different treatment groups

A Metabolism trial of 7 days was conducted at the end to assess nutrient digestibility. The daily feed intake and faeces voided by the calves were recorded during the metabolism trial of seven days. Samples were analysed for proximate constituents as well as various fibre fractions in all the treatment groups and the data obtained were compiled for calculation of digestibility coefficients of dry matter (DM), organic matter (OM), crude protein (CP), ether extract (EE), crude fibre (CF), nitrogen free extract (NFE), neutral detergent fibre (NDF),acid detergent (ADF) and hemicellulose (HC) for assessment of nutrient availability from experimental feed. The animals were harnessed with faecal bags and urine bags, three days prior to actual collection period (7 days) for the acclimatization.

Samples of feed offered, residues left, and faeces and urine were analysed for proximate constituents as per AOAC (2016).Determination of ether extract in feed and faeces was done with the help of SOCS PLUS (Pelican Equipments). Determination of crude fibre in feed and faeces was done with the help of FIBER PLUS (Pelican Equipment). For determination of dry matter and total ash, standard conventional procedures were followed. The conventional Weende's methods were followed for calculation of nitrogen free extract.

The data obtained in the experiment were analysed 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

Nutrient composition of feed is considered as a preliminary index for the assessment of quality of feed. The per cent chemical composition of concentrate mixture, hydroponics maize green fodder, basal roughage and yeast (*Saccharomyces cerevisiae*) are given in Table 1.

Table 1. Chemical Composition of Experimental Feed (% DM Basis)

Attributes	DM	OM	CP	EE	CF	NFE	TA	NDF	ADF	HC	Ca	P
Concentrate Mixture	89.7	88.6	20.0	3.35	10.0	55.2	11.3	38.4	20.6	17.8	1.34	0.56
Hydroponics Maize Fodder	18.2	96.9	18.6	3.56	8.62	66.1	3.01	34.7	15.9	18.8	0.27	0.42
Wheat Straw	91.1	89.0	3.14	1.09	39.0	45.7	10.9	75.0	52.3	22.2	0.30	0.10
Yeast (*S.cerevisiae*)	99.3	93.6	39.5	2.74	3.63	47.7	6.36	-	-	-	1.83	0.76

The mean values of dry matter intake (DMI) in terms of g/d, kg/100kg b.wt. and g/kg $W^{0.75}$ ranged between 3555 - 3710, 2.83 - 3.12 and 94.9 -103.1, respectively in different treatment groups. The results of statistical analysis of data revealed highly significant effect ($P<0.01$) of treatments and periods on DMI (Table 2).

Table 2. Average Dry Matter Intake (DMI) in Different Treatment Groups

Attributes	T1	T2	T3	T4	T5	T6	T7	T8	T9
g/d	3710.84^{a}	3650^{cd}	3624^{d}	3595^{e}	3555^{f}	3687^{ab}	3654^{c}	3626^{d}	3586^{e}
kg/100 kg Body weight	3.12^{a}	3.03^{ab}	2.96^{bc}	2.83^{d}	2.85^{d}	3.03^{ab}	2.93^{c}	2.84^{d}	2.88^{cd}
g/kg $W^{0.75}$	103^{a}	100^{b}	$98.5b^{c}$	94.9^{c}	95.2^{c}	100^{ab}	98.2^{c}	95.5^{c}	96.1^{c}

The average digestibility coefficient of DM, OM, CP, EE, CF, NFE, NDF, ADF and HC ranged between 61.2–67.8, 63.3–70.0, 63.8–71.0, 72.2–73.8, 50.62–55.9, 61.4–69.9, 52.8–56.5, 44.0–46.8 and 69.5– 74.2%, respectively in different treatment groups (Table 3).

Table 3. Average digestibility coefficient of dry matter, gross nutrients and fibre fractions in different treatments Groups

Attributes	T1	T2	T3	T4	T5	T6	T7	T8	T9	SEm±
DM	61.2^{f}	62.8^{ef}	64.4^{cd}	67.4^{ab}	66.6^{b}	63.1^{de}	64.8^{c}	67.8^{a}	66.9^{b}	.702
OM	63.3^{c}	64.3^{c}	66.9^{bc}	69.0^{a}	68.0^{b}	65.0^{c}	67.8^{b}	70.0^{a}	68.4^{ab}	0.740
CP	63.8^{e}	65.4^{d}	67.1^{cd}	69.8^{ab}	67.5^{c}	66.6^{d}	68.7^{bc}	71.0^{a}	68.1^{b}	0.745
EE	72.2	73.0	73.1	73.5	73.2	73.2	73.4	73.8	73.4	0.813
CF	50.6^{d}	51.2^{cd}	52.0^{b}	53.8^{ab}	52.2^{b}	51.8^{bc}	52.7^{b}	55.9^{a}	53.3^{b}	0.726
NFE	61.4^{e}	63.2^{d}	65.1^{c}	67.9^{ab}	68.6^{a}	64.8^{cd}	66.7^{b}	69.9^{a}	69.0^{a}	0.749
NDF	52.8	54.0	54.5	55.2	55.6	54.4	54.8	56.1	56.5	0.756
ADF	44.0^{c}	44.5^{b}	45.2^{b}	46.2^{ab}	46.6^{a}	44.8^{b}	45.6^{b}	46.4^{a}	46.8^{a}	0.518
HC	69.5	71.2	73.3	73.8	74.1	71.4	73.6	74.2	74.2	1.166

Rows and columns with different superscript differ significantly

The results of statistical analysis of variance revealed highly significant (P<0.01) effect of treatment i.e., feeding of hydroponics maize fodder at different levels with and without probiotic (*Saccharomyces cerevisiae*) on DM, OM, CP, CF, NFE and ADF digestibility in calves. There was non-significant effect of treatments on EE, NDF and HC digestibility (Table 4).

Table 4. ANOVA of average digestibility coefficient of dry matter, gross nutrients and fibre fractions

Attribute	Source of Variance	D.f.	MSS	F Value	Level of Sig.
DM	Treatment	8	21.5	10.923	**
	Error	27	2.0		
OM	Treatment	8	20.7	9.425	**
	Error	27	2.2		
CP	Treatment	8	19.0	8.533	**
	Error	27	2.2		
EE	Treatment	8	0.7	0.274	NS
	Error	27	2.6		
CF	Treatment	8	10.0	4.728	**
	Error	27	2.1		
NFE	Treatment	8	32.8	14.580	**
	Error	27	2.2		
NDF	Treatment	8	5.1	2.222	NS
	Error	27	2.3		
ADF	Treatment	8	4.1	3.819	**
	Error	27	1.1		
HC	Treatment	8	11.5	2.114	NS
	Error	27	5.4		

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

Thus, statistically there was no effect of feeding of hydroponics maize fodder at different levels with and without supplementation of probiotic (*Saccharomyces cerevisiae*) on average digestibility coefficients of EE, NDF and HC.

The comparison of average digestibility coefficients of DM, OM, CP, CF, NFE and ADF by DNMRT indicated statistically significant variations among different treatment groups. The average digestibility coefficients of DM and OM were highest in group T8, followed by T4, T9, T5, T7, T3, T6, T2 and T1 (control). The lowest average digestibility coefficients of DM and OM were observed in group T1 i.e., control. Further, there were non-significant differences in average digestibility coefficients of DM in group T2 and T6; T3 and T7; T4 and T8; and T5 and T9 (Table 3).

The average digestibility coefficient of CP was highest in group T8, followed by T4, T7, T9, T5, T3, T6, T2 and T1 (control). The lowest average digestibility coefficient of CP was observed in group T1 i.e., control. There were non-significant differences in average digestibility coefficients of CP in group T2 and T6; T3 and T7; and T4 and T8. Further, average digestibility coefficient of CP in T5 was statistically different with that of T9. The average digestibility coefficient of CF was highest in group T8, followed by T4, T9, T7, T5, T3, T6, T2 and T1 (control). The lowest average digestibility coefficient of CF was observed in group T1 i.e., control. Further, mean values of digestibility coefficients of CF were statistically at par in group T2 and T6; T3 and T7; T4 and T8; and T5 and T9. The average NFE digestibility was highest in group T8, followed by T9, T5, T4, T7, T3, T6, T2 and T1 (control). The lowest average NFE digestibility was observed in group T1 i.e., control. Further, there were non-significant differences in average NFE digestibility in group T2 and T6; T4 and T8; and T5 and T9. The average ADF digestibility was highest in group T9, followed by T5, T8, T4, T7, T3, T6, T2 and T1 (control). The lowest average ADF digestibility was observed in group T1 i.e., control. The value of ADF digestibility in group T9 was statistically at par with that of T8, T5, and T4 whereas value of ADF digestibility in group T2 was at par with T3, T4, T6 and T7 (Table 3).

The digestibility of nutrients (digestibility coefficients of DM, OM, CP, CF, NFE) was highest in calves of group T8 (i.e.,75% CP of concentrate mixture replaced by hydroponics maize green fodder with supplementation of *Saccharomyces cerevisiae*) and lowest in T1 (control). Thus, feeding of hydroponics maize fodder with supplementation of probiotic has significantly improved the digestibility of nutrients in calves.The findings of the present investigation suggested an improvement in digestibility of DM, OM, CP, CF, NFE and ADF on account of replacement of 25%, 50%, 75% and 100% CP of concentrate mixture through hydroponics maize fodder with and without supplementation of probiotic.The comparison of means by DNMRT indicated non-significant variations in digestibility of EE, NDF and HC among different treatment groups (Table 3).

Findings of present investigation are in agreement with that of Fayed (2011), Naik et al. (2014), Verma et al. (2015), and Al-Saadi et al. (2016).There was significant improvement in OM, CP and EE digestibility in ewes fed sprouted barley on tamarix or rice straw(Fayed,2011). Addition of 7% DM maize hydroponic fodder (MHF) in corn silage maintained nutrient digestibility in dairy cows(Nugrohoa et al.,2015).

As far as effect of supplementation of probiotic (*Saccharomyces cerevisiae*) on nutrient digestibility was concern, several workers have shown similar findings as that of present investigation (Rao et al.,2001,Miller-Webster et al., 2002,Fadel El-seed et al., 2004,El-Waziry and Ibrahim,2007,Bhima et al.,2014,Ghazanfar et al.,2015and Hassan et al.,2016). Rao et al. (2001) observed enhanced the digestibility of nutrients by feeding of *Saccharomyces cerevisiae.*On similar lines, Miller-Webster et al. (2002) reported that digestion of DM improved by feeding of yeast.Fadel El-seed et al. (2004) reported that supplementation of *S. cerevisiae* in the diet of Nubian kids increased OM digestibility. There was a positive effect of yeast supplementation on digestion of DM, OM, CP, CF, ADF and CF(Bhima et al.,2014 andGhazanfar et al.,2015). Findings of Rajendra Prasad et al.(1998) and Hafla et al. (2014) were in contrast to that of present investigation but none of them used hydroponics maize green fodder in calves replacing CP of concentrate mixture at different levels.

CONCLUSION

It was concluded that digestibility of nutrients (DM, OM, CP, CF, NFE) was highest in calves of group T8 (i.e.,75% CP of concentrate mixture replaced by hydroponics maize green fodder with supplementation of *Saccharomyces cerevisiae*) and lowest in group T1 (control). Feeding of hydroponics maize fodder with supplementation of probiotic (*Saccharomyces cerevisiae*) has significantly improved the digestibility of nutrients in calves.

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