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Effect of Hydroponic Maize Fodder Supplementation on Growth Performance, Nutritive Ratio and Intake of Digestible Nutrient in Gir Calves

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Abstract

A study was undertaken to assess the effect of addition of hydroponic maize fodder in concentrate mixture on growth performance of gir calves. A feeding trial of 120 days was undertaken on 16 gir calves divided in four groups of four calves. The animals in control group were fed 1.5 kg concentrate mixture, 2.5 kg groundnut straw and wheat straw ad lib. In group second, 75% of CP was met through concentrate mixture and rest through hydroponic maize fodder along with 2.5 kg groundnut straw and ad lib. wheat straw was given. While, in third group, 50% of CP was met through concentrate mixture and rest through hydroponic maize fodder and 2.5 kg of groundnut straw was given along with ad lib. wheat straw. In group fourth, 25% of CP was met through concentrate mixture and remaining by hydroponic maize fodder and 2.5 kg groundnut straw with ad lib. wheat straw was offered. Significantly higher daily weight gain, digestible crude protein percent, total digestible nutrient percent and intake of digestible dry matter and organic matter in respect of g D^{-1} was observed in the group in which up to 75% of crude protein of concentrate mixture was replaced by hydroponic maize fodder. Highest (p<0.01) digestible crude protein intake and total digestible nutrient intake g D^{-1}, Kg 100 kg BW^{-1} and g 100 kg^{-1} MBS (Metabolic body size) was observed in group provided with 75% crude protein through hydroponic fodder. Hydroponics maize fodder has beneficial effect on growth performance and intake of digestible nutrients in gir calves and it can replace up to 75% of crude protein of concentrate mixture.

Keywords: Hydroponic fodder, daily weight gain, nutritive value

1. Introduction

Green fodder is an important component of livestock feed and plays a significant role in their health, production, and reproductive performance. However, faster industrialization or urbanization has reduced the pasture land available, resulting in a failure to meet the animals' green fodder needs. Lack of good quality green fodder has a negative impact on livestock health and hence there is a need to search all possible feed resources for animal production (Safwat, 2014). Recently, the hydroponic fodder industry has been advertised extensively worldwide, which renewed the interest of livestock producers and scientists as well (Prakash, 2017). Hydroponic green forage is defined as highly palatable sprouts, of heights ranging from 15 to 20 cm, produced by soil-less germination of cereal grains (barley, maize etc.) and using water with

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a mineral nutrient solution (Anonymous, 2001). It is a viable farmer-friendly interesting alternative for crop cultivation for landless farmers whose soil is rocky and infertile. Hydroponic fodder is produced from germinated grains and grown under optimal conditions in greenhouses in a short period of time (Sneath and Felicity, 2003) and germinated grains have been used to make fodder since the 1600s (Pedretti, 2013). The term hydroponics is derived from two Greek words: hydro, which means "water," and ponic, which means "working." Thus, hydroponics fodder, sprouted grains, or sprouted fodder is fodder produced by growing plants in water or nutrient-rich solution without the use of soil (Dung et al., 2010). Hydroponics technology can be produced daily up to 1000 kg maize fodder from 45–50 m^2 area which is equivalent to fodder produced by conventional methods in 25 acres of cultivable land (Naik and Singh, 2013, Rachel et al., 2015). Green fodder for hydroponics is obtained from forage grains with a high germination rate that are grown for a short period of time in a special chamber with the right growing conditions. It has high metabolizable energy, crude protein and digestibility (El-Morsy et al., 2013). Many changes occur during seed sprouting, such as seed protein being converted to essential amino acids, carbohydrates being converted to sugar, and fats being converted to essential fatty acids. Increased enzyme levels result in an increase in these activities (Chavan and Kadam, 1989; Prakash, 2017). Hydroponic fodder are rich source of antioxidants in the form of Beta-carotene, Vitamin A, E and C and rich in lysine an essential amino acid. Feeding of hydroponics maize fodder improves the DM intake, weight gain and cost per kg body weight gain of calf (Rajkumar et al., 2018). Hydroponic maize and barley fodder alone and in combination improves the digestibility of nutrients and growth performance of goat (Kide et al., 2015, Dadhich et al., 2019). Many forage crops can be grown in a hygienic environment free of chemicals like insecticides, herbicides, fungicides, and artificial growth promoters using the hydroponic technique (Al-Hashmi, 2008; Al-Karaki and Al-Momani, 2011). It is good source of chlorophyll improve the performance of livestock and eliminates antinutritional factor such as phytate (Naik et al., 2015, Girma and Gebremariam, 2018). The hydroponic fodder is free from antibiotics, hormones, pesticides, or herbicides (Naik, 2014), had positive effects on ewe's health, mortality, conception rate and abortion (Saidi and Abo Omar, 2015). The hydroponic fodder decrease heat stress and increase birth rates (Farghaly et al., 2015), improves the DM intake, lowers the cost per kg body weight gain (Rajkumar et al., 2018). Keeping in view the aforesaid facts, the present experiment was undertaken to assess effect of hydroponic maize fodder supplementation on growth performance, nutritive ratio and intake of digestible nutrient in gir calves.

2. Materials and Methods

2.1. Experimental animal and design

16 male Gir calves of similar age group (6-12 month of age) and uniform conformation from dairy farm of College of Veterinary and Animal Science, Navania, Vallabhnagar were included in the experiment. Animals were housed in well ventilated, hygienic and protected sheds and acclimatize for a period of 10 days prior to experimental feeding. The animals were given prophylactic doses of panacure as anthelmintic. Faecal and blood smears were examined periodically for parasitic infestation. The experimental Gir calves were distributed by randomized block design on the basis of body weight into four groups of four animals in each.

2.2. Experimental feed

Hydroponics maize fodder was produced in a hydroponics chamber of Ayurvet Progreen machine equipped with automatic irrigation. Clean maize seeds were soaked for overnight in tap water and thereafter distributed in trays. On first day, trays were placed in the top most row of growth chamber and then everyday were shifted to the respective lower rows. Inside the growth chamber the plants were allowed to grow for the duration of 7 days. The plants reach the height of 25–30 cm within 7 days and then harvested on eight day for feeding to the animals.

The animals in group T_1 (control) were fed 1.5 kg concentrate mixture (CP 20%), 2.5 kg groundnut straw and wheat straw ad lib. In group T_2, 75% of CP was met through concentrate mixture (1.125 kg) and rest through hydroponic maize fodder (2.63 kg) along with 2.5 kg groundnut straw and ad lib. wheat straw was given. While, in group T_3, 50% of CP was met through concentrate mixture (0.75 kg) and rest through hydroponic maize fodder (5.27 kg) and 2.5 kg of groundnut straw was given along with ad lib. wheat straw. In group T_4, 25% of CP was met through concentrate mixture (0.375 kg) and remaining by hydroponic maize fodder (7.9 kg) and 2.5 kg groundnut straw with ad lib. wheat straw was offered. Daily allowance of concentrate and roughage were offered to meet their nutrient requirements.

2.3. Experimental procedure and parameter studied

2.3.1. Daily weight gain

The body weights of experimental animals were recorded at the start of experiment and at the end of the experiment with the help of digital balance as the change in body weight is very reliable measure of performance of animals subjected to various treatments.

2.3.2. Digestibility study

At the end of 120 days experimental feeding, a digestibility trial of 7 days was conducted for estimation of digestibility of the nutrients. Faecal bags were used for collection of faeces from each animal. Collection of faeces was done daily at 8:30 am. Faeces was weighed by counter balance. During the period of collection, faecal samples of each animal were taken after thorough mixing. For the purpose of N determination, sample of faeces was taken and preserved in 10 ml of 40% H_2SO_4 in Kjeldahl flask. Whereas, for determination of dry

matter and proximate principles sample of faeces was dried at 100°C in the oven and pooled for 7 days for individual animals. The pooled samples were ground and used for further analysis. Samples of feed offered and faeces were analyzed for proximate constituents as per Anonymous (2000). The total nitrogen content of feed and faeces were determined following standard Kjeldahl's method using Kel Plus Semi-automatic Nitrogen Analyzer. Estimation of ether extract and crude fibre in feed and faeces was done with the help of Socs plus and Fibra plus semi-automatic analyzer. For estimation of dry matter and total ash standard conventional procedures were followed. From the data obtained on the intake and outgo of crude protein, crude fiber, ether extract and nitrogen free extract during the digestion trial, digestibility coefficient of same nutrients was calculated by using the equation given below. The intake of digestible nutrients was calculated in terms of digestible dry matter intake, digestible organic matter intake, digestible crude protein intake, total digestible nutrient intake (DDMI, DOMI, DCPI and TDNI) and expressed in respect of g D^{-1}, kg 100 kg BW^{-1} and g 100 kg^{-1} MBS.

Crude protein intake-Crude protein outgo

Digestibility coefficient of crude protein (%)={(Crude protein intake-Crude protein outgo)/Crude protein intake}×100

Similarly, digestibility coefficient of crude fiber, ether extract and nitrogen free extract were calculated.

The total digestible nutrient was calculate by using following equation

% Total digestible nutrient=% Digestibility coefficient of crude protein+% Digestibility coefficient of crude fiber+% Digestibility coefficient of nitrogen free extract+(2.25x% Digestibility coefficient of ether extract)

Nutritive ratio was calculate by using following equation

Nutritive ratio={(% Total digestible nutrient-% Digestibility coefficient of crude protein)/% Digestibility coefficient of crude protein}

2.4. Statistical procedure

The data obtained in the experiment were analyzed using statistical procedures as suggested by Snedecor and Cochran (1994) and Significance of mean differences was tested by Duncan's New Multiple Range Test (DNMRT).

3. Results and Discussion

3.1. Effect on daily gain, % DCP, % TDN and NR

The results presented in Table 1 revealed significant (p<0.01) effect of hydroponics maize fodder by replacing the crude protein requirement of concentrate mixture at different levels on average daily gain. The effect was more pronounced in group T_4 where 75% of crude protein of concentrate mixture was replaced by hydroponics maize fodder followed by T_3, T_2 and T_1. Kide et al. (2015) reported significant increase in daily body weight gain in a group of goats fed with hydroponic maize fodder @ 20%, 40% and Mixed maize+barley hydroponic fodder (20%:20%). Ata (2016) revealed significant (p<0.05) effect on average daily gain of Awassi lamb fed with hydroponics maize fodder as compared to control group. Rajkumar et al. (2018) revealed significant (p<0.01) effect on average daily gain in a group of crossbreed calves supplemented with 7% of CP through hydroponics maize fodder.

Table 1: Effect of hydroponics maize fodder on average daily gain g D^{-1}, % DCP, % TDN, and NR in Gir calves

	Treatment groups				
	T_1	T_2	T_3	T_4	SEM
Initial body weight kg	97.23	96.70	98.07	98.47	0.52
Final body weight kg	133.81^c	136.91^c	141.33^b	145.75^a	1.30
Average daily gain g D^{-1}	307.39^a	337.91^b	363.54^c	397.29^d	3.31
DCP %	8.93^a	9.88^b	10.23^c	10.73^d	0.01
TDN %	53.01^a	55.035^b	55.84^b	58.03^c	0.30
NR	4.69^a	4.74^a	4.65^a	4.77^a	0.04

Note: Means with different superscripts in a row differ significantly from each other

The statistical analysis of data showed highly significant effect (p<0.01) of feeding of hydroponics maize fodder on % digestible crude protein, % total digestible nutrient and non-significant effect on nutritive ratio. The results showed significantly lower value of % DCP and % TDN in T_1 group as compared to T_2, T_3 and T_4 group.

The findings of present investigation are in accordance with the results of Misra et al. (1996) who observed significant increase in DCP and TDN values of cows fed on artificially grown barley fodder. Reddy et al. (1988) reported significant (p<0.05) increase in DCP% and TDN% values in the artificially grown barley fodder based ration than the NB-21 grass based ration in cow. Similarly, Naik et al. (2014) recorded significant increase in DCP values and non-significant increase in TDN values in cows fed with hydroponics maize fodder. Similarly Reddy et al. (1991) reported that DCP % and TDN % was higher in cows fed 20 kg artificial grown barley fodder than the 10 kg artificial grown barley fodder. Further, Verma et al. (2015) recorded significant (p<0.05) increase in DCP % and highly significant (p<0.01) TDN % in Haryana calves fed with hydroponics barley fodder. Dadhich et al. (2019) also reported significant effect (p<0.01) of hydroponics maize fodder on DCP% and TDN% percent in rathi calves.

3.2. Effect on intake of digestible nutrients

The intake of digestible nutrients was calculated in terms of DDMI, DOMI, DCPI and TDNI and expressed in respect of g D^{-1}, Kg 100 kg BW^{-1} and g 100 kg^{-1} MBS as shown in Table

2. The statistical analysis of data revealed highly significant (p<0.01) effect on DDMI and DOMI in terms of g D^{-1} but non-significant effect in terms of kg 100 kg BW^{-1} and g 100 kg^{-1} MBS. Statistically highest DDMI and DOMI g D^{-1} were observed in was observed in group provided with 75% crude protein through hydroponic fodder and lowest was observed in control group. Statistically highest DCPI and DTDNI g D^{-1}, kg 100 kg BW^{-1} and g 100 kg^{-1} MBS were observed in group which was observed in group provided with 75% crude protein through hydroponic fodder and lowest was observed in control group.

Naik et al., 2017 reported partial replacing hydroponic maize fodder with maize grain of concentrate mixture improved dry matter intake per 100 kg body weight. Farghaly et al. (2019) reported hydroponic barley fed to sheep improved intake of dry matter. Dadhich et al. (2019) observed significant (p<0.05) increase in digestibility of DMI g d^{-1} and g kg^{-1} $W^{0.75}$ and digestibility of OMI, CPI and TDNI g d^{-1}, kg 100 kg^{-1} b.wt and g kg^{-1} $W^{0.75}$ in a group of rathi calves provided with 75% crude protein through hydroponics maize fodder as compared to control whereas non-significant effect was observed in digestibility of DMI for kg 100 kg^{-1} b.wt. Helal (2020) observed TDN g Kg^{-1} BW and DCP % increased significantly (p<0.05) using sprouted barley grain in goats.

Table 2: Effect of hydroponics maize fodder on intake of digestible nutrients in gir calves

Attribute	Treatment groups				
	T_1	T_2	T_3	T_4	SEM
DDMI					
g D^{-1}	2582.60^{a}	2728.26^{ab}	2838.78^{bc}	3024.05^{c}	37.68
Kg 100 kg BW^{-1}	1.92	1.98	2.00	2.06	0.01
g 100 kg^{-1} MBS	65.53	68.05	69.11	71.93	0.96
DOMI					
g D^{-1}	2411.99^{a}	2547.27^{ab}	2651.70^{bc}	2786.79^{c}	29.73
Kg 100 kg BW^{-1}	1.79	1.85	1.87	1.90	0.02
g 100 kg^{-1} MBS	61.2	63.53	64.55	66.29	0.74
DCPI					
g D^{-1}	246.53^{a}	297.48^{b}	330.14^{c}	350.75^{c}	2.15
Kg 100 kg BW^{-1}	0.18^{a}	0.21^{b}	0.23^{c}	0.23^{c}	0.001
g 100 kg^{-1} MBS	6.25^{a}	7.41^{b}	8.03^{c}	8.34^{c}	0.056
TDNI					
g D^{-1}	2343.78^{a}	2501.09^{b}	2550.32^{b}	2707.45^{c}	13.36
Kg 100 kg BW^{-1}	1.74^{a}	1.82^{b}	1.80^{b}	1.85^{c}	0.01
g 100 kg^{-1} MBS	52.45^{a}	55.31^{b}	56.19^{b}	58.72^{c}	0.27

Note: Means with different superscripts in a row differ significantly from each other

4. Conclusion

Hydroponics maize fodder has beneficial effect on daily weight gain, digestible crude protein percent, total digestible nutrient percent and intake of digestible dry matter, digestible organic matter g D^{-1} and intake of digestible crude protein, total digestible nutrient g D^{-1}, Kg 100 kg BW^{-1} g, 100 kg^{-1} MBS in gir calves and hence it can replace up to 75% of crude protein of concentrate mixture.

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