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Study on Effect of Hydroponic Maize Fodder on Performance of Bengal Goat

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ABSTRACT

The objective of that trial was to explore the effect of hydroponic maize (HM) feeding on the performance of Bengal goat. A total of 18 nos. of Bengal goats were divided into two groups used in a feeding trial. The Control group was fed a total mixed ration diet while the goats of the second group were fed similar ration except that maize grain was 100% replaced by HM for 70 days of feeding trial. Goats were fed ad libitum feed and fresh water twice daily. Daily feed offered and feed refusals were measured, while the body weight gain was recorded weekly, and feed conversion ratio (FCR) was determined. Results of the trial interpreted that HM had a positive effect on feed intake, final body weight, total weight gain, average daily gain, and FCR on Bengal goats when compared with the goats fed with Control diet. Thus, it can be concluded that feeding of hydroponic maize fodder with concentrate improve the DM intake, feed conversion ratio and growth performance of Bengal goats in terms of body weight gain.

HIGHLIGHTS

- Addition of HM instead of maize grains in goats' diet improves the growth performance and body weight gain.
- Use HM as an alternative fodder for goat and other livestock for local farmers.

Keywords: Bengal goats, Hydroponic maize, Growth performance

Livestock feed and fodder production serve as crucial pillars of animal husbandry for ensuring sustainability (Johnson *et al.,* 2022). Bengal goats play a significant role in providing supplementary income and sustainable livelihoods to poor and landless farmers in rural India. Traditional grazing methods for goat rearing in rural India are facing challenges due to diminishing common grazing areas caused by urbanization, population growth, shrinking land sizes for fodder cultivation, water scarcity, labor requirements, and high fertilization costs (Singh *et al.,* 2020). Currently, less than 4% of land in India is dedicated to green fodder cultivation and according to Dikshit and Brithal (2021), India's demand for concentrates, dry fodder, and green fodder is estimated to be 56,526 million tons, 855 million tons, and 855 million tons respectively. Meeting such demands for green fodder production can be challenging and may have adverse effects on the productive and reproductive performances of livestock. To address this, hydroponic fodder has emerged as a potential solution to supplement livestock feed diets and improves performance (Roy *et al.,* 2023). Hydroponics is a simple method of cultivating seeds to enhance their nutritive value (Vassileva *et al.,* 2022). It allows for the production of fresh green fodder from grains such as Oats, Barley, Wheat, and others (Roy *et al.,* 2023). Hydroponic fodder production requires minimal

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land and has a short growth period of around 7-10 days (Singh *et al.,* 2020). It is rich in proteins, fibers, vitamins, and minerals, offering health benefits to animals (Mohan *et al.,* 2021). Hydroponic fodder comprises germinated grains along with the roots, which are palatable and fully consumed by animals without any wastage (Kumar *et al.,* 2022). Overall, hydroponic culture has emerged as a crucial technique for green fodder production in many countries (Singh *et al.,* 2020).

MATERIALS AND METHODS

Experimental animals and diets

The study was conducted at Murshidabad Krishi Vigyan Kendra under West Bengal University of Animal and Fishery Sciences. Total eighteen (18 nos.) Bengal goats (average age 10-16 months) were randomly divided into two treatment groups using completely randomized design, so that each group had nine animals. All goats were treated with anthelmintics before the commencement of the experiment to ensure the goats were free of intestinal worm.

Table 1: Ingredients and chemical composition of the experimental diets

	Diets[1]	
Ingredients (% of the diet)	**Control**	**HM**
HM	0	56
Grind Maize	56	0
Grind Mustard oil cake	11	11
Rice Bran	12	12
Broken Rice	13	13
Oyster Shell	6.4	6.4
Mineral and Vitamins[2]	0.2	0.2
Table Salt	1.4	1.4
Nutrients (%)		
DM	88.3	86.8
OM	87.9	87.6
CP	15.1	15.5
NDF	39.4	41.1
ADF	22.9	21.5

[1]Diets were: Control (Cont; n=9) and hydroponic maize (HM; n=9); [2]Composition per 1000 g contained (Dicalcium phosphate, 800 g; Sodium chloride, 60 g; Trace elements mixture, 20 g (Zn, Mn, Fe, Cu, Co, Se); Magnesium oxide, 20 g; Vit. A, 500,000 IU; Vit. D3, 85,000 IU, Vit. E, 200 IU)

The goats were kept in same housing conditions and provided individual feeders and water buckets. The goats were allowed 10 days of adaptation period during which they were gradually introduced to the experimental diets. Goats were fed ad libitum twice per day at 8 am and 4 pm using plastic buckets with free access to fresh water. The green maize fodder was fed as part of total mixed ration (MR) (Table 1). Two diets were formulated in this study as i) Control diet with no hydroponic maize but with maize grains and ii) HM diet with hydroponic maize but without maize grains (Table 1). Study was conducted for 70 days. Daily feed intake was recorded by measuring feed offered and feed refusals, while the body weight gain was recorded weekly. Average daily gain and feed conversion ratio was calculated at the end of the study.

Hydroponic maize fodder

A hydroponic system is composed of two units with bamboo frame each with dimensions (30 cm × 100 cm × 120 cm). Each unit consist of three shelves to carry 4 planting tray. Polystyrene trays were used for growing seeds to produce green fodder. Recently harvested good quality yellow maize seeds with less than 12% moisture were selected. The required quantity of seeds *i.e.* 12 kg/ machine were soaked in tap water for 22 hours. Water was then drained and the seeds were packed in gunny bags for germination. Water was sprinkled periodically over the gunny bag to maintain moisture. After 24 hours, seeds were taken out from the gunny bags and loaded onto different hydroponic fodder trays at the rate of 1 kg per tray (dry weight). The seed loaded trays were then kept on the lowest row of the hydroponic fodder machine. Water was sprinkled every hour for about 5 minutes. The trays were shifted to immediate upper row daily. After 9 days of the growth period in the machine, the fodders were taken out on the 10th day for feeding to goat.

Chemical Analysis

Hydroponic fodder and ration samples were collected and oven-dried at 70°C for 48 hours, weighed, and analyzed using the proximate analysis procedure (Table 1 and 2). Proximate analysis for collected samples was conducted and crude protein, crude fiber, crude fat, and dry matter contents were determined according to the procedures of AOAC (2000). Acid detergent fiber (ADF) and Neutral

detergent fiber (NDF) was determined (Van Soest *et al.,* 1991).

Table 2: Chemical Composition of hydroponic maize (on dry weight basis)

Item%	Hydroponic maize fodder
Dry matter	16.58
Crude protein	12.44
Crude fibre	9.49
Ether extract	2.65
ADF	14.2
NDF	35.4

STATISTICAL ANALYSIS

The experimental design used for this study was complete randomized design. Analysis of variance was performed using the Statistical Analysis System (SAS, version 9.1 2000, SAS Inst. Inc., Cary, NC). Differences among the means were determined by the Duncan's multiple range tests with a significance defined at $P < 0.05$.

RESULTS AND DISCUSSION

A study was conducted by feeding of Bengal goats diets which contain maize grains (Control diet) and hydroponic maize (HM fodder) to explore its effect on growth performance. Table 3 shows the growth performance that was affected by the different diets. Initial body weight for goats was not different ($p = 0.05$) at the beginning of the study.

Table 3: Growth performance of Bengal goats fed with concentrate diets with hydroponic maize

	Diets[1]			
Item	**Control**	**HM**	**SD**	**P-value**
Initial body weight (kg)	11.16	10.52	0.68	0.071
Final body weight (kg)	13.11	13.04	0.69	0.835
Total weight gain (kg)	2.66	3.52	0.12	0.000
Overall ADG (g/ day)	38.05	50.25	1.67	0.000
Dry matter intake (g/day)	273.10	386.27	8.95	0.000
FCR	7.20	7.81	0.50	0.115

[1]Diets were: Control (Cont; n=9) and hydroponic maize (HM; n=9)

Final body weight was higher for goats fed with HM diet than goats fed with Control diet *i.e.* 13.04 kg vs. 13.11 kg respectively. Total weight gain (Final body weight – Initial body weight) was significantly higher ($p < 0.05$) of goats fed with HM diet *i.e.* 3.52 kg, when compared to goats fed with Control diet *i.e.* 2.66 kg.

The total DMI was higher *i.e.* 386.27 g/day in group HM diet over Control diet (273.10 g/day), which indicates that incorporation of hydroponic maize fodder in the diet increase the palatability. Similar observation were noticed by Weldegerima (2015) reported that average DM Intake of growing goat was highest due to addition of hydroponic maize and barley fodder in T5 (504.51 g/D). Devendra and McLeory (1983) observed that DM intake in meat-type goats hardly exceeded 3% of live weight. Ranjhan (1980) reported that DM intake in goats varied from 1.5 to 3.7% of live weight. Kabir *et al.* (2002a) mentioned that DM intake of goat was 3.5% of live weight. The present finding on DM intake corresponds well with the above observations.

Even though there was statistical difference, numerically higher overall average daily gain was noticed in Bengal goats supplemented with hydroponic maize fodder (50.25 g) observed in the present study were higher than that reported by Thiruvenkadan *et al.* (2009) in Tellicherry female kids (35.87±1.77 g) and also reported significantly ($P<0.05$) higher daily weight gain (g/day) in Konkan Kanyal goats fed 60:40 Finger millet straw (FMS) and hydroponic maize fodder (HMF) and 60:20:20 FMS + HMF + hydroponic barley fodder (HBF). Ata (2016) studied the effect of hydroponic barley fodder on Awassi lambs performance also reported higher ($P<0.05$) average daily gain in lambs fed hydroponic barley (HB) diet (266 g/ gained/day) than lambs fed the Control diet (191 g/gained/ day). The improved weight gain might be due to feeding of hydroponics fodder which increased the digestibility of the nutrients attributed to the tenderness of the fodder Naik *et al.* (2014). Pandey and Pathak (1991) also stated that the digestibility of the nutrients of the hydroponics fodder was comparable with the highly digestible legumes like berseem and clovers.

Feed conversion ratio (FCR) was affected by the trial diets and was higher for goats fed HM diet when compared with the goats fed the Control diet (7.81 vs. 7.20). Table shows, final body weight and total gain was improved by goats

fed HM diet than Control diet. This was in line with the concept of Naik *et al.* (2014) who reported that hydroponic sprouts is a rich sources of bioactive enzymes and may contain ingredients that improves the performance of livestock. Tudor *et al.* (2003) found that the increase in weight gain of lambs offered barley sprouts may reflects the effect of microbial activity in the rumen and how enhanced nutrient digestibility. Similar researchers also noticed that using maize hydroponic fodder has been reported to improve the performance of birds and animals up to 8%. There are several factors described as influencing feed intake as production level, temperature, type and quality of forage, breed, and concentrate ration. In our study, feed intake was not affected by adding HM probably due to the lower palatability of goats to HM diet than to the Control diet. Average daily gain and FCR on the other hand were improved with goats fed with HM diet than goats fed with Control diet. Researchers used other type of animals for investigating the effect of HM on their performance. Cuddeford (1989) described some possible advantages of hydroponic sprouts fed to horses. Morgan *et al.* (1992), on the other hand, found that pigs fed 4-day-old sprouts gained significantly less weight than those fed barley grain. In our study, a positive effect of feeding HM to goats was shown, which reflects that feeding this type of feed might be of great benefit to farmers for increasing profit from the goat meat industry.

CONCLUSION

Due to lack of pastures and high cost of fodder, it is so important to utilize alternative fodders with low cost and with high nutritive value. Hydroponic is one of the greatest solutions of the shortage in the green fodder found in West Bengal. Inclusion of hydroponic maize instead of maize grains in the diet of Bengal goats increases the DMI, improve the growth performance in terms of body weight and economics in term of body weight gain. Therefore, it is recommended for local farmers to use HM as an alternative fodder for goat and other livestock.

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