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Effect of replacement of concentrate mixture by hydroponic maize fodder on nutrient intake and nutrient digestibility of sangamneri goats

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Abstract
The experiment was conducted to study effect of replacement of concentrate mixture by hydroponic maize fodder on nutrient intake and nutrient digestibility of Sangamneri goats. Thirty Sangamneri male goats of 6-9 month age were kept under five treatments and six replication using RBD. T_0 (concentrate mixture), T_1+ (replace 20% concentrate by hydroponic maize), T_2 (replace 40% concentrate by hydroponic maize), T_3 (replace 60% concentrate by hydroponic maize) and T_4 (replace 80% concentrate by hydroponic maize). (Roughages = dry + green) fed to all treatment.
It was observed that hydroponic green maize contents 18.25, 11.75, 11.43, 03.36, 3.11, 0.47 and 68.35, DM, CP, CF, EE, Total Ash, Silica and NFE respectively. Result of experiment indicate that replacing of concentrate with hydroponic maize fodder had significantly higher DMI in (T_2) 719 gram/ day than other treatments. Inclusion of hydroponic maize in kid's diet reduces the water intake. FCR value had non-significant influence to all treatments. Average nutrient digestibility observed significantly higher DM, CP and NFE in T_2 (66.78, 83.52 and 66.27%) and higher CF observed in T_0 (67.10%) than other treatments. The B: C ratio indicate that the animal fed under T_2 give higher B:C ratio of 1:1.13. Concentrate mixture can be replaced with HMF at 40% level in the rations of growing kids increases dry matter intake and nutrient digestibility without affecting feed conversion efficiency and reduce the production cost.

Keywords: Concentrate mixture, hydroponic maize fodder, nutrient intake, nutrient digestibility, sangamneri goats

Introduction
In India, livestock is crucial for the nutritional security of all farmers, but especially for small and marginal farmers. Because of their enormous economic contribution to the poor man, goats have been referred to as "Poor man's cow." Goat farming is the backbone of economy of small and landless farmers in India. About 70% of the population in India works in agriculture, either directly or indirectly.
In the Ahmednagar district of Maharashtra's "Sangamner" Tehsil, Sangamneri goats are a dual-purpose breed. The breed is also found in adjoining districts like Pune, Solapur, Nashik and Dhule. The breed is often kept in small flocks of 2 to 10 goats and is found in irrigated regions. There were also a few bigger herds of 50–100 goats.
Dr. W.F. Gerke from the University of California first looked into hydroponics in the latter part of the 1930s. The name hydroponic is derived from two Greek words, hydro, which means "water," and ponic, which means "working." This hydroponic, sprouted grain, or sprouted fodder is created by growing plants in water or nutrient solution without the use of soil. In a short period of time, hydroponics is developed in a controlled environment. This problem is solved by the hydroponic green fodder production, which produces food with adequate fodder yields and excellent value during periods of drought and scarcity. The science shows that, there is great nutritional benefit provided by hydroponic sprouted grain and it is suitable for all livestock including sheep, cattle, goat provides animals with improved growth and overall health.
Hydroponic sprouting feed offers a significant nutritional advantage that can improve the overall health and performance of young animals while lowering feed costs. As a result, it has been planned for the current study to replace hydroponic fodder for a portion of the concentrate in the goat kids' diet.

Material and Methodology

The hydroponic green maize was cultivated in unit setup at AICRP on Goat Improvement unit using 75 percent green shed net cover for maintaining optimum temperature (22-27 °C) and humidity (70%) equipped with semi-automated sprayer irrigation. The trays size 2X1.5 ft. with hole at the base to allow drainage of excess water. Daily requirement of maize hydroponic fodder is obtained by rotational soaking and sprouting of maize seed. Average 6-7 kg hydroponic maize fodder was produced from 1 kg maize seeds on 8th day. Thirty Sangamneri male goats of 6-9 month age were kept under five treatments and six replication using RBD. T_0 (concentrate mixture), T_1+ (replace 20% concentrate by hydroponic maize), T_2 (replace 40% concentrate by hydroponic maize), T_3 (replace 60% concentrate by hydroponic maize) and T_4 (replace 80% concentrate by hydroponic maize). (Roughages = dry + green) fed to all treatment.

The concentrate mixtures replaced with hydroponic green maize supplied to balance energy and protein to all the groups. Goats were dewormed before starting the feeding trial and fed similar ration for 90 days. After the completion of feeding trial a digestion trial of seven days duration was conducted to estimate the digestibility of proximate nutrients. Daily dry matter and water consumption were recorded. Goats were weighted using weighing balance. The biometric measurements *viz*., body length, chest girth, and wither height of all goats were recorded weekly before access to feed and water. The sample of feed and fodder for dry matter, crude protein, crude fibre, ether extract, Silica and total ash were analyzed (AOAC 1995) [1]. The cost of feeding was calculated by taking the prevailing ration and feed ingredients. Randomized Block Design used for statistical analysis with six goats per treatment. Thirty goat kids aged between 6-9 months with average weight of 15 kg were used for the study. The ANOVA comprising of replication, treatment error, sampling errors and total were considered in the analysis as suggested by Rangaswamy (2000) [10].

Result and Discussion

1. Proximate principles

The proximate compositions of Soybean straw, Lucerne, green maize, Hydroponic green maize, Maize grain, GNC, Wheat bran and Rice bran are presented in Table 1. It was observed that the CP, EE and NFE content in hydroponic green maize fodder was more than green maize and lower CF content indicates higher palatability. The present findings are agreeable with previous reports (Thadchanamoorthy *et al*. (2012) [12], Weldegerima, 2015 [14, 15, 16], Naik *et al*. 2014 [9], Muthuramalingam *et al*. 2015) and Naik *et al*. (2016) [6, 7, 8]

2. Dry matter intake (DM basis), feed conversion ratio and water intake (lit)

The data on DMI, growth performance, water intake and feed conversion efficiency are illustrated in Table 2. The average daily DMI (kg/d) of kids was significantly (p<0.05) higher in T2 than other treatment groups followed by treatment groups T3, T4, T1 and T0 rations, whereas T0 was significantly (p<0.05) lower intake. Intake per 100 kg body weight (kg) of kids was significantly (p<0.05) higher in T2 ration and found at par with T1, T2, T3 and T4, whereas T0 was significantly (p<0.05) lower intake and found at par with T1. It might be due to encouraged faster passage rateout of the rumen leading to increased intake. Similar results were found by Verma *et al.* (2015) [13] that DMI was higher in Haryana male calves fed hydroponic barley fodder at 50 percent replacement of concentrate mixture.

The differences in average water intake and total water intake were statistically significant (p<0.05), treatment T_0 & T_1 is found at par with each other and treatment T_1, T_2, T_3 and T_4 are at par with each other and water intake per 100 kg body weight were also found significant. Treatment T_0 shows highest water intake and being significantly higher (p<0.05) with rest of the treatments. The water intake was decreased in groups under successive period of investigation. It is further noticed that there was significant differences in water intake when Sangamneri goats were supplemented with hydroponic maize fodder. Feeding of hydroponic maize decreases water intake in experimental goats.

The FCR was not significantly different among the experimental rations. Goats fed with replacing 40% hydroponic maize fodder with concentrate mixture to treatment group T_2 consume lowest dry matter per kg gain than treatment group T_0, T_1, T_3 and T_4. It was low probably due to the enhance digestibility of nutrient and more nutritive value under this treatment, Hence it is indicated that replacing 40% maize fodder with concentrate mixture was efficient for growth of animal as compared to rest of treatments.

3. Average nutrient intake (g/d) and nutrient digestibility (%)

3.1 Dry Matter intake (g/d) and Digestibility (%)

Significantly highest intake recorded in treatment group T_2. Treatment group T_1, T_2, T_3 and T_4 were non-significant and treatment group T_0 and T_1 at par with each other. DM digestibility coefficient was higher in 40 percent replacement of concentrate mixture with HMF ration than other rations and significantly (p<0.05) differed to control group. Treatment group T1, T2 and T3 are non significant, treatment group T1, T3 and T4 are at par with each other and Treatment group T0 and T4 are non-significant. Similar results were reported by Verma *et al.* (2015) [13] that, significantly (p<0.05) higher digestibility of DM was observed in Haryana male calves fed hydroponic barley fodder based diets compared to control.

3.2 Crude Protein intake (g/d) and Digestibility (%)

Significantly (p<0.05) highest intake recorded in treatment group T_2. Treatment group T_2 and T_3 are non-significant, treatment group T_3, T_4 and T_1 are non-significant and Treatment group T_4, T_1 and T_0 are non-significant. CP digestibility coefficient was higher in 40 percent replacement of concentrate mixture with HMF ration than other rations and significantly (p<0.05) differed to control group. Treatment group T_1, T_2, T_3 and T_4 are non-significant. Higher CP digestibility might be a reflection of its sprouting activity, which may increase the enzymatic activity in the seeds and leads too many changes as seed proteins are converted to essential amino acids. Similar results were found by Naik *et al.* (2014) [9] in cows fed hydroponic fodder.

3.3 Crude Fiber intake (g/d) and Digestibility (%)

Significantly (p<0.05) highest intake recorded in treatment group T_2. Treatment group T_2 and T3 are non-significant. Treatment group T_0, T_1, T_3 and T_4 are non-significant. Significantly higher (p<0.05) CF digestibility was found in

goat kids T0 ration. T1 and T2 are non-significant, T3 and T4 are non-significant. Present finding agreement with Devender et. al (2020) [2] fed hydroponic Barley fodder to sheep control (58.48%) reported higher CF digestibility than replace 50% concentrate by HBF (53.92%) and replace 75% concentrate by HBF (48.00%).

3.4 Ether Extract intake (g/d) and Digestibility (%)

There was no significant difference in ether extract digestibility among three experimental rations. There was no significant difference in ether extract digestibility among three experimental rations. Similar results were also observed by Verma *et al.* (2015) [13] in Haryana male calves fed hydroponic barley fodder based diets.

3.5 Nitrogen Free Extract intake (g/d) and Digestibility (%)

Significantly (p<0.05) highest intake recorded in treatment group T_2. Treatment group T0, T2, T3 and T4 are non significant and treatment group T0, T1 and T4 are non-significant. Highest NFE (p<0.05) digestibility coefficient was observed in goat kids T3 ration and lowered in T0 ration. T2 and T3 were comparable and treatment group T1and T4 was at par. Similar results were reported by Reddy *et al.* (1988) [11] that, digestibility of NFE was significantly (p<0.01) higher in cross-bred cows fed artificially grown fodder compared to NB-21 fodder.

4. Economics of feeding of experimental goats

T2 group showed lowest production cost per kg body weight gain (i.e.174.42 Rs) and highest B:C ratio. Lower production cost per kg gain in body weight of growing kids were in agreement with the observations of Naik *et al.* (2014 [9] There was higher net profit of Rs. 12.67 per cow/d on feeding HMF. The present finding similar with result given by Jemimah *et al* (2020) [4] hydroponic maize fodder may be included in the diet of fed Tellicherry crossbred female kids replacing concentrate at 25% and 50% level for enhanced weight gain with the added advantage of the reduced cost of production/kg live weight gain. Also comparable with the reports and concept by Fazaeli *et al.* (2011) [3] and Naik *et al.* (2014) [9]

Table 1: Proximate principles of experimental feeds fed to goats (% DM basis)

Proximate composition	DM	CP	CF	EE	Total Ash	Silica	NFE
Soybean straw	89.66	3.03	41.61	0.94	4.37	0.68	50.05
Lucerne	30.00	18.76	24.33	1.04	8.01	0.81	47.86
Green Maize	25.10	9.91	27.59	1.69	8.92	3.03	51.89
Hydroponic Maize	18.25	11.75	11.43	3.36	3.11	0.47	68.35
Maize grain	91.76	7.84	2.86	2.45	1.54	0.12	85.31
GNC	92.59	46.77	7.22	5.37	7.18	2.74	33.46
Wheat bran	88.21	15.21	8.79	2.80	3.63	0.40	69.57
Rice bran	90.24	13.67	7.02	5.44	9.65	2.71	64.22

Table 2: Average dry matter intake (DM basis), feed conversion ratio and water intake (lit) by experimental goats

Treatment	T_0	T_1	T_2	T_3	T_4	SE.m	CD at 5%
Initial Weight(kg)	14.65	15.43	15.68	15.63	15.37		
Final weight(kg)	19.38^{d}	20.69^{bc}	21.86^{a}	21.10^{b}	20.34^{c}	0.2537	0.7485
Average body weight (kg)	16.96^{c}	18.03^{ab}	18.72^{a}	18.32^{ab}	17.82^{b}	0.254	0.7491
Total Gain (kg)	4.73^{e}	5.26^{c}	6.18^{a}	5.47^{b}	4.97^{d}	0.0355	0.1047
Total daily DM Intake (kg)	0.572^{d}	0.650^{c}	0.719^{a}	0.692^{b}	0.664^{c}	0.0081	0.024
Intake per 100 kg body weight (kg)	3.37^{b}	3.60^{ab}	3.84^{a}	3.78^{a}	3.73^{a}	0.1108	0.327
Total feed consumption DM (kg)	51.45^{d}	58.52^{c}	64.70^{a}	62.24^{b}	59.75^{c}	0.7311	2.1585
FCR (%)	10.88	11.13	10.47	11.38	12.02	0.5033	N.S
Water intake / day	0.69^{a}	0.64^{ab}	0.62^{b}	0.59^{b}	0.60^{b}	0.0197	0.0581
Total water intake/kid	62.10^{a}	57.60^{ab}	55.80^{b}	53.10^{b}	54.00^{b}	1.7722	5.2279
Water intake /100 kg body weight	4.09^{a}	3.55^{b}	3.31^{b}	3.21^{b}	3.37^{b}	0.1176	0.3471
DM to water intake ratio	01:01.2	01:01.0	01:00.9	01:00.8	01:00.9		

Table 3: Average nutrient intake (g/d) and nutrient digestibility (%)

Attributes	T0	T1	T2	T3	T4	SE.m	CD 5%
DM							
Intake (g/d)	571.65^{b}	650.39^{ab}	718.86^{a}	692.98^{a}	664.07^{a}	27.96	82.50
Digestibility (%)	56.98^{c}	63.13^{ab}	66.78^{a}	62.20^{ab}	59.73^{bc}	2.07	6.11
CP							
Intake (g/d)	33.20^{c}	36.20^{bc}	45.12^{a}	41.20^{ab}	39.51^{bc}	1.64	4.85
Digestibility (%)	69.90^{c}	79.48^{ab}	83.52^{a}	82.32^{ab}	82.07^{ab}	3.13	9.25
CF							
Intake (g/d)	107.49^{b}	105.96^{b}	125.16^{a}	118.45^{ab}	112.01^{b}	4.27	12.59
Digestibility (%)	67.10^{a}	64.88^{ab}	64.48^{ab}	59.08^{c}	59.77^{bc}	1.89	5.57
EE							
Intake (g/d)	27.51	27.12	29.17	28.79	27.34	1.19	N. S
Digestibility (%)	75.28	71.83	72.60	71.82	69.98	3.04	N. S
NFE							
Intake (g/d)	373.12^{ab}	334.41^{b}	410.0^{a}	400.94^{a}	384.25^{ab}	17.42	51.39
Digestibility (%)	57.78^{b}	60.78^{ab}	65.17^{a}	66.27^{a}	60.98^{ab}	2.03	6.00

Table 4: Economics of feeding of experimental goats

Particulars	T0	T1	T2	T3	T4
Total feed cost (Rs)	5699.39	6049.03	6467.53	6213.77	5757.57
Feed cost per Animal	949.89	1008.17	1077.92	1035.62	959.59
Initial cost of goat @ 300 Rs/kg live weight	4395	4629	4704	4689	4611
Total cost (feed cost per animal + initial cost of goat)	5344.89	5637.17	5781.92	5724.62	5570.59
Final return of goat @ 300 Rs/kg live weight	5814	6207	6558	6330	6102
Feed cost /kg body weight gain (Rs)	200.82	191.66	174.42	189.32	193.07
B:C ratio	1:1.08	1:1.10	1:1.13	1:1.10	1:1.09

Conclusion

- Upon feeding of hydroponically grown green maize fodder replace to 40% concentrate on DM basis to goat kids along with control green and dry roughages resulted highest nutrient digestibility in term of dry matter, crude protein and nitrogen free extract.
- Based on present investigation, it is concluded that concentrate mixture could replace with hydroponic maize fodder at 40% level in the ration of growing kids is beneficial for better nutrient intake, digestibility and economic profitability of Sangamneri goat kids.

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