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Productive performance and economics of Tellicherry buck kids fed varying levels of hydroponic maize fodder

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Green fodder is an essential component of the livestock ration to enhance their productive and reproductive performance (Dung *et al*. 2010). Now-a-days, it is very difficult to supply quality green fodder throughout the year due to various reasons like constraints in availability of fertile land, shrinkage of grazing land and pastures, scarcity of water and labour for agricultural operations (sowing, earthing up, weeding, harvesting etc.), more harvest time (approx. 60 days) and natural calamities (Naik *et al.* 2012). The 34th report of the Parliamentary Standing Committee on Agriculture has also indicated a shortage of 122 million tonnes of dry fodder, 284 million tonnes of green fodder and 35 million tonnes of concentrate in the country by 2020 (NAPG 2018).

Hence, it is inevitable to produce quality green fodder by alternative methods for feeding livestock in future. One such alternative method is hydroponic fodder production which provides year-round supply of fresh green fodder while using minimal labour, land, water and space (Sneath and Mclntosh 2003, Naik *et al*. 2011, 2013). It is one of the emerging technologies widely adopted in many parts of the world and proved as the most feasible and easily adoptable one for improving the growth and reproduction in farm animals (Gebremedhin 2015). Hydroponic fodder is a germinated grain with shoots and root, highly palatable and consumed without any wasting (Pandey and Pathak 1991). It has high feed quality and is rich in proteins, fibres, vitamins, and minerals (Bhise *et al*. 1988, Chung *et al*. 1989) that has beneficial effects on animals (Boue *et al*. 2003). In India, hitherto limited research was done on the beneficial effect of feeding hydroponic maize fodder to the small ruminants. Hence, this study was attempted to study the growth performance of Tellicherry buck kids fed with hydroponic maize fodder.

Tellicherry buck kids (24) aged around 3 months were randomly selected and allotted into 3 treatment groups namely, treatment 1 (100% concentrate mixture), treatment 2 (75% concentrate + 25% hydroponic maize fodder) and treatment 3 (50% concentrate + 50% hydroponic maize fodder) consisting of 8 animals each. All the animals were reared under similar standard management conditions. Study was conducted for 9 months. Hydroponic maize fodder was produced using the low cost hydroponic green fodder machine fabricated at University Innovation and Instrumentation Centre (UIIC), TANUVAS as per the method suggested by Jemimah *et al*. (2020).

Nutritional composition of feed and fodders were analyzed as per AOAC (2005) (Table 1).

Based on the results of proximate analysis of feed and fodders, the experimental ration was formulated using 'Maryland Meat Goat Ration Evaluator' as per 'National Research Council's Nutrient Requirements of Small Ruminants' published in 2007. Separate ration was for formulated for the different body weight stages such as 10 –15 kg, 15–20 kg, 20–25 kg and 25–30 kg as per NRC (Table 2).

The body weight of all the kids was recorded initially and subsequently at fortnight intervals from 3 months to 1 year of age. Known quantity of concentrate, hydroponic maize fodder, CO5 grass, COFS 29 dry fodder and tree fodder were offered to the kids every day and the residual feed was recorded on the subsequent morning to calculate the actual amount of feed consumed (kg/day). Dry matter feed intake was calculated by multiplying the feed consumed by dry matter content of the consequent feed/ fodder. The overall body weight gain was calculated by subtracting initial body weight from final body weight. The average daily gain during the study period was calculated by subtracting initial body weight from final body weight of any particular period. The feed conversion efficiency is expressed as kilograms of live weight produced per kg of dry matter fed. Body condition scores were recorded at monthly interval as per the method suggested by Villaquiran

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Table 1. Proximate composition of experimental feed and fodders

Feed/ Fodder	Moisture (%)	DM (%)	CP (%)	EE (%)	CF (%)	TA (%)	NFE (%)	TDN (%)
Goat concentrate feed	6.86	93.14	16.28	1.76	11.85	12.12	58.29	73.31
Hydroponic maize fodder	83.42	16.58	12.44	2.65	9.49	2.77	72.65	82.22
CO5 grass	74.15	25.85	10.42	1.75	36.95	10.85	40.03	68.55
Mixed tree fodder	70.11	29.89	8.5	3.04	13.85	9.24	65.30	75.89
COFS29 dry fodder	10.85	89.15	7.45	1.15	21.22	10.08	60.10	89.92

Table 2. Quantity of feed and fodders fed to different body weight stages and treatment groups

Body weight stages (kg)	Treatment 1 (Control) Conventional feeding					Treatment 2 25% HMF + 75% concentrate					Treatment 3 50% HMF + 50% concentrate				
	Concentrate feed	CO5 Grass	Hydroponic maize fodder	COFS 29 dry fodder	Tree fodder	Concentrate feed	CO5 Grass	Hydroponic maize fodder	COFS 29 dry fodder	Tree fodder	Concentrate feed	CO5 Grass	Hydroponic maize fodder	COFS 29 dry fodder	Tree fodder
	(g)					(g)					(g)				
10 – 15	150	300	0	100	200	112.5	3000	227	100	200	75	300	454	100	200
15 – 20	175	500	0	150	200	131.25	500	272	150	200	87.5	500	544	150	200
20 – 25	200	1500	0	200	250	150	1500	286	200	250	100	1500	567	200	250
25 – 30	250	1650	0	200	250	187.5	1650	340	200	250	125	1650	680	200	250

et al. (2004) with 0.5 increments. Cost of production / kg live weight gain (₹) was calculated using the formula

$$\text{Cost of production/kg live weight gain (₹)} = \frac{\text{Cost of feeding during the period (₹)}}{\text{Total body weight gain during the period (kg)}}$$

The cost of feeding per animal per day for each treatment group was calculated using the formula

$$\text{Cost of feeding/animal/day (₹)} = \frac{\text{Total cost of feeding/animal}}{\text{Total number of days}}$$

The collected data were subjected to statistical analysis by analysis of variance using SPSS software.

The initial body weight of Tellicherry buck kids observed at 3 months in the present study is in agreement with the report of Senthil Kumar and Daisy (2008) who reported the body weight of Tellicherry male kids at 3 months of age as 12.20±0.29 kg.

Kids in all the three groups had statistically similar initial body weight, final body weight, overall weight gain, average daily gain, body condition score, dry matter fed and intake per day, feed conversion efficiency, cost of production/kg live weight gain (₹) and cost of feeding/ animal/day (₹) (Table 3). The results are statistically in agreement with Rachel *et al.* (2017) who found no adverse effects on ADG in Tellicherry goat kids fed hydroponic horse gram or sun hemp fodder replacing 50% of the concentrate mixture. However, though there was no statistical difference, hydroponic maize fodder fed kids had numerically higher final body weight, higher overall weight gain and higher average daily gain than the concentrate fed group. These findings are in agreement with

Table 3. Productive performance and economics of Tellicherry buck kids fed varying levels of hydroponic maize fodder

Parameter	Treatment 1 (Control)	Treatment 2 (25% HMF)	Treatment 3 (50% HMF)	F value
Initial body weight (kg)	11.85±0.68	12.75±0.55	13.23±0.27	1.74^{NS}
Final body weight (kg)	23.73±1.59	27.82±1.87	28.22±1.02	2.59^{NS}
Total weight gain (kg)	11.88±1.26	15.07±1.48	14.99±0.92	2.13^{NS}
Overall ADG (kg/day)	0.042±0.04	0.054±0.06	0.054±0.07	1.16^{NS}
Dry matter fed (g/day)	545.29±61.88	590.21±67.70	628.64±68.78	0.40^{NS}
Dry matter intake (g/day)	517.20±61.90	560.92±67.68	599.52±68.77	0.39^{NS}
Feed conversion efficiency (%)	8.37±0.89	9.72±0.95	9.02±0.55	0.67^{NS}
Body condition score	2.81±0.04	2.86±0.04	2.91±0.03	1.79^{NS}
Cost of production/kg live weight gain (₹)	143.39±22.71	112.94±12.11	111.30±7.58	1.36^{NS}
Cost of feeding/animal/day (₹)	5.70±0.51	5.80±0.57	5.90±0.53	0.04^{NS}

NS, Non-significant.

Gebremedhin (2015) who reported significantly (P<0.05) higher total body weight gain (kg) and 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). Mysaa Ata (2016) also reported higher (P<0.05) total gain and average daily gain in Awaasi lambs fed hydroponic barley when compared to lambs fed control diet.

The higher final body weight and overall body weight gain and average daily gain of the kids in the hydroponic fodder fed groups might be due to the presence of antioxidants, bioactive enzymes and other ingredients in the hydroponic fodder (Naik *et al.* 2014) which directly acts as a catalyst for the complete digestion of protein, fats and carbohydrates leading to increased animal growth (Al-shaadi and Al-Zubiadi 2016). The highly soluble protein and amino acids in response to the early plant growth and enzymatic transformations of sprouted grains are also responsible for the improved digestibility in animals (Chung *et al*. 1989). Though the DM intake was similar, the increased growth performance in the hydroponic fodder fed groups may be due to improved digestibility in the kids.

Further, no significant difference was noticed between the treatment groups in terms of dry matter fed, dry matter intake, feed conversion efficiency and body condition score. The results of the present study are in agreement with Saidi and Omar (2015) who reported no effect of feeding hydroponic barley on the feed intake (FI), body weight changes, milk yield, and milk composition in lactating Awassi ewes. Rachel *et al*. (2017) also reported no significant difference in total feed intake/head/30 day on DM basis and feed conversion efficiency between the control and groups with 50% replacement of concentrate mixture with hydroponic horse gram fodder or hydroponic sun hemp fodder group. Naik *et al.* (2017) also reported that feeding of HMF by replacing the maize grain of the concentrate mixture had not altered the DM intake (11.20 vs 11.52 kg/ day) in lactating cows. Thus, feeding hydroponic fodder will not affect the dry matter intake of the animals.

Body condition score (BCS) is the best simple indicator of available fat reserves which can be used by the animal in periods of high energy demand (Villaquiran *et al.* 2004). The body condition score recorded in the present study are in agreement with Villaquiran *et al.* (2004) implying that kids in the treatment groups had better fat reserves. Thus, feeding hydroponic fodder will not affect the body condition of the kids.

Though, hydroponic maize fodder feeding increased the cost of feeding/animal/day (₹) slightly, it reduced the cost of production/kg live weight gain (₹) compared to control group (Table 3). The results are in agreement with Adebiyi *et al.* (2018) who reported that feeding pigs with 50% concentrate and 50% hydroponics maize fodder (Con50HM50) as compared to 100% concentrate (Con100) and 100% hydroponics maize fodder (HM100) is more profitable and economically efficient in terms of feed cost per weight gain to feed pigs. Gebremedhin (2015) also reported that feeding of finger millet straw + hydroponic maize and barley fodder at a proportion of 60:40 for growing Konkan Kanyal goats (T3, T5, and T4) was highly beneficial and economically valid. Saidi and Omar (2015) reported that, 42% of the feed cost in raising lactating Awaasi ewes can be reduced by incorporating hydroponic barley as a feed in the TMR instead of wheat straw. Thus, hydroponic maize fodder may be fed at 25 and 50% replacing concentrate mixture for better growth in Tellicherry buck kids with added advantage of reduced cost of production/ kg live weight gain.

To conclude, the present study finds that feeding hydroponic maize fodder to Tellicherry buck kids enhances its growth without affecting its dry matter intake and body condition. Further, it reduces the cost of production/kg live weight gain. Thus, hydroponic maize fodder can be fed to Tellicherry buck kids replacing concentrate at 25 and 50% levels for better growth and profit.

SUMMARY

The present work was carried out to study the growth performance and economics of Tellicherry buck kids fed varying levels of hydroponic maize fodder. Tellicherry buck kids (24) were divided into three groups and fed with diets consisting of 100% concentrate, 75% concentrate + 25% hydroponic maize fodder and 50% concentrate + 50% hydroponic maize fodder respectively. Kids supplemented with hydroponic maize fodder replacing concentrate at 25% and 50% level had numerically higher overall weight gain, average daily gain, final body weight and lower cost of production/kg live weight gain (₹) than 100% concentrate fed kids. From the study, it can be concluded that the concentrate can be replaced with hydroponic maize fodder at 25% and 50% levels in the diets of Tellicherry buck kids for better growth and profit.

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