International Journal of Veterinary Sciences and Animal Husbandry

**ISSN:** 2456-2912
VET 2024; 9(1): 241-245

www.veterinarypaper.com
Received: 02-10-2023
Accepted: 06-11-2023

**Hayavadana GR**
MVSc Scholar, Department of Animal Nutrition, Veterinary College, KVAFSU, Bidar, Karnataka, India

**Preetam Sangam**
MVSc Scholar, Department of Animal Nutrition, Veterinary College, KVAFSU, Bidar, Karnataka, India

**Jaishankar N**
Professor, Department of Animal Nutrition, Veterinary College, KVAFSU, Karnataka, India

**Chethan KP**
Associate Professor (i/c), Department of Livestock Farm Complex, HVC, KVAFSU, Bidar, Karnataka, India

**Shivakumar MC**
Dean (i/c), Veterinary College, KVAFSU, Bidar, Karnataka, India

**Ramachandra B**
Professor, Department of Animal Nutrition, Veterinary College, KVAFSU, Bidar, Karnataka, India

**Guruprasad R**
Associate Professor (i/c), Department of Livestock Production and Management, HVC, KVAFSU, Bidar, Karnataka, India

**Hemanth Gowda K**
Assistant Professor, Department of Veterinary Physiology and Biochemistry, HVC, KVAFSU, Bidar, Karnataka, India

**Corresponding Author:**
**Hayavadana GR**
MVSc Scholar, Department of Animal Nutrition, Veterinary College, KVAFSU, Bidar, Karnataka, India

# Growth potential and nutrient utilization by Hassan sheep lambs under intensive rearing system

**Hayavadana GR, Preetam Sangam, Jaishankar N, Chethan KP, Shivakumar MC, Ramachandra B, Guruprasad R and Hemanth Gowda K**

**Abstract**
The study conducted with twenty Hassan sheep lambs of 3-4 months age and average body weight of 9.0 kgs, which were divided into four groups randomly as per completely randomized design and all the groups were fed *ad libitum* green fodder COFS-29 as sole source of roughage. The control group ($T_1$) was fed compounded feed mixture (CFM) composed of maize and soybean as major ingredients at maintenance level, CFM was fed to meet 50 g gain ($T_2$), 100 g gain ($T_3$) and 150 g gain ($T_4$) per day as per ICAR (2013) requirements to assess growth potential, intake and digestibility in Hassan lambs under intensive system of rearing.The feeding cum growth trial was conducted for 90 days. The ADG and DMI improved linearly across treatment groups; voluntary intake of COFS-29 was found to be 2.73% of body weight. OM, CP, EE and NFE intake significantly increased with higher CFM intake and no significant difference with intake of CF, NDF, ADF, cellulose and hemicellulose. The digestibility of DM, OM, CP, EE and NFE increased significantly but didn't affect CF digestibility and observed positive nitrogen balance in all the groups. Hence, it is concluded that the growth potentiality of Hassan sheep lambs was 100 g per day, when fed as per ICAR 2013 under intensive system.

**Keywords:** COFS-29, growth, Hassan lambs, intensive system, nutrient digestibility

## Introduction
Sheep provide livelihood to landless and marginal farmers for economic progress. They make up a substantial portion of the livestock population, and better management and breeding procedures will increase their output. However, adequate balanced feeding is the major constraint in obtaining profit from sheep farming in the extensive system. They are usually raised on grazing pastures that do not consistently provide enough of all the nutrients for all types of sheep throughout the year. The feeding of crop leftovers and natural pastures can be complemented by the use of fodder tree/shrub legumes due to their high protein, mineral, and vitamin contents and availability throughout the dry season. In ruminant nutrition effective use of conventional green fodder and unconventional roughage helps to alleviate the feed resource scarcity (Jaishankar *et al.* 2017) [6]. Various crop residues can be used as roughage source during fodder scarcity as sugarcane trash when subjected for urea ammoniation improved digestibility of sugarcane trash as *in vitro* results showed increased metabolizable energy, truly digestible organic matter and microbial biomass production (Jaishankar *et al.*, 2018) [7]. Lambs with the maximum body weight at market age can ensure highest possible income from sheep farming to the farmer. There is no sufficient literature available as of now on growth potentiality of Hassan sheep breed. In order to sustain this business, it is necessary to rear those sheep flock in intensive system to achieve maximum body weight. Intensive feeding requires adapting animals from natural pasture and supplying them with a greater level of nutrition in a feedlot with judicious use of green fodder and specialized managemental practices. The present study was conducted to evaluate the growth potentiality of Hassan sheep lambs reared in intensive system with COFS 29 as sole roughage source.

## Materials and Methods

The experiment was carried out at the experimental animal shed, Department of Animal Nutrition, Veterinary College Hassan in Collaboration with the Department of Livestock Farm Complex, Veterinary College, Hassan to assess the growth performance of Hassan sheep lambs. The experiment was conducted for a duration of 90 days in twenty Hassan sheep lambs and divided into four dietary treatment groups of five lambs each. Uniform managemental care like deworming, vaccination etc., were given as per standard procedure under intensive rearing system. *Ad libitum* COFS 29 roughage was fed to lambs and CFM supplemented as per ICAR (2013) was given as to meet maintenance levels and to support daily body weight gains of 50, 100, and 150 g respectively in $T_1$, $T_2$, $T_3$ and $T_4$ as shown in Table 1. The daily allowance of CFM was weighed and offered twice a day at 12.00 PM and 4.00 PM. The leftover feed was recorded the next day at 9.30 AM every day. Clean drinking water was provided at free of choice to all the animals. During this feeding trial of 90 days, individual data on total DMI, weekly body weights were recorded. The daily allowance of CFM was revised weekly taking into consideration the change in body weight of lambs.

**Table 1:** The experimental diets for feeding Hassan sheep lambs was designed as follows

| Group | Experimental Diet |
|---|---|
| Treatment 1 | Free choice feeding of green fodder COFS-29 and CFM at maintenance level as control group. |
| Treatment 2 | Free choice feeding of green fodder COFS-29 and CFM for 50 g daily body weight gain. |
| Treatment 3 | Free choice feeding of green fodder COFS-29 and CFM for 100 g daily body weight gain. |
| Treatment 4 | Free choice feeding green fodder COFS-29 and CFM 150 g daily body weight gain. |

## Metabolic trial and chemical analysis

At the end of the ninety days feeding trial, two animals of comparable body weight from each group were subjected to a metabolic trial for five days with adaptation for a period of three days to assess the nutrient utilization. The CFM and COFS29 roughage was offered and residue were weighed daily to determine the daily feed DM intake. The dung and urine voided from each animal was collected for 24 hrs was weighed/measured every day at 9.00 AM to assess the nutrient digestibility of lambs under different treatment groups. Daily urine voided by the animals were collected in 2.5 litre plastic bottles containing 20ml 25% sulphuric acid. From each animal, 1/5th of the total dung voided was used for DM estimation every day, 1/50$^{th}$ urine voided was collected separately every day and pooled samples over 5 days of collection period was preserved in deep freezer for N estimation. The dried dung samples over 5 days collection period were pooled, ground to pass through 1mm sieve and stored in air tight polyethylene containers for further analysis. Proximate composition of the pooled samples of feed, fodder, residues, dung and urine were analyzed according to AOAC, (2005) [1]. The fibre fractions were analyzed as per. The N content was determined by macro kjeldhal method as per the procedure of AOAC, (2005) [1].

## Statistical Analysis

The data of body weight, body weight gain, DMI, various nutrient intake and digestibility of nutrients were analyzed statistically using analysis of variance technique. The data on feeding trial and metabolism trial was subjected to statistical analysis by one way Anova and interpreted accordingly.

## Results and Discussion

### Chemical composition

The detailed chemical composition of green fodder COFS-29, CFM used for feeding of experimental animals in the growth trial are presented in Table 2. The results of the proximate analysis of the green fodder COFS-29 were comparable to values for wheat straw reported by Bendary *et al*. (2002) [3]; Akinfemi *et al*.(2009b) [2] noticed nutrient profile for maize which was lesser in its chemical composition compared to sorghum used in the present study. Similar results were observed by Kalyana Chakravarthi *et al.* (2017) [10], However Ram Rajitwad *et al.* 2020, reported that the proximate composition of perennial fodder sorghum (Heera variety) was comparable with C0FS-29 sorghum. The untreated sugarcane trash had 3% CP whereas the urea ammoniated sugarcane trash has higher crude protein (11.98) as reported by Jaishankar *et al.,* (2017) [6] which can be comparable with COFS-29 fodder.

**Table 2:** Chemical composition (%DMB) of roughage COFS-29 and CFM

| Proximate composition | Roughage CoFS-29 (%) | Concentrate feed mixture (%) |
|---|---|---|
| Dry matter | 30.33 | 87.77 |
| Organic matter | 93.36 | 93.72 |
| Crude protein | 8.75 | 24.79 |
| Ether extract | 2.34 | 3.67 |
| Crude fibre | 34.27 | 4.47 |
| Nitrogen free extractives | 48.00 | 60.79 |
| Ash | 6.64 | 6.28 |
| Acid insoluble ash | 2.09 | 0.7 |

### Body weight and Average daily gain

The initial body weights varied non-significantly between the treatment groups. Whereas, the final body weight varied significantly between the treatment groups but there was no significant difference between $T_3$ and $T_4$ group. The ADG (g/d) was 23.24, 40.63, 83.46 and 90.69 g respectively in $T_1$, $T_2$, $T_3$ and $T_4$ groups. average weekly body weight gain (g/d) was statistically significant with higher gain in $T_4$ (90.69 g) group when compared to $T_1$, $T_2$ and $T_3$ as a result of an increase in CFM intake to achieve maximum gain. Which might also be due to higher nutrient absorption from concentrates, which helps lambs for better growth. Similar results were reported by Jaishankar *et al*, (2021) [8] in Narisuvarna × Kenguri $F_1$ lambs (109.52 g/day), KUMARI *et al.* (2013) [12] in Nellore lambs (86.30 g/d). Woyessa *et al.* (2013) [18] Horro breed lambs (93.8 g/day) ADG was gain tended to increase for the higher CP intakes. Dessie *et al.* (2010) [19] observed that lamb with a high level of CFM supplementation had higher final BW and daily BW gain than those fed with hay alone in control treatment.

**Dry Matter intake**

The total dry matter intake (g/d), percent body weight and per Kg metabolic body weight (g/kg $BW^{0.75}$) is presented in Table 3. The average total dry matter intake except during 2nd, 4th and 9th week other weeks had no significant difference. $T_3$ and $T_4$ showed ($p<0.05$) higher total dry matter intake compared to $T_1$ and $T_2$. There was no significant difference found between $T_3$ and $T_4$. The same pattern was seen for both percent body weight and per kg metabolic (g/kg BW0.75). Total dry matter was higher and better in $T_4$ (579.84) group due to increase in proportion of concentrate dry matter intake. But significantly lower DMI from roughage was observed as the proportion of CFM increased in the diets. Higher concentrate DMI observed due to better palatability than the roughage source. Lamb body size is also one of the factors that influence higher dry matter intake. As higher body weight is directly proportional to dry matter intake. The same pattern was noticed by Tamir and Asefa, (2009) [17] as inclusion of *Acacia saligna* leaves had better DMI comparatively when sole hay showed lesser dry matter intake. Similar results was also observed by Jaishankar *et al*., (2021) [8] in Nari Suwarna × Kenguri F1 lambs when sugarcane trash as sole roughage source and concentrate fed separately.

**Table 3:** Mean body weight and dry matter intake of experimental Hassan sheep lambs

| Parameters | $T_1$ | $T_2$ | $T_3$ | $T_4$ | SEM | P Value |
|---|---|---|---|---|---|---|
| Body weight kg | 12.50a | 14.10ab | 16.20b | 16.50b | 0.769 | 0.006 |
| Body weight g/d | 23.24a | 40.63b | 83.46c | 90.69d | 1.089 | 0.001 |
| TDMI(g) | 376.07a | 462.12b | 546.81c | 579.84c | 13.410 | 0.001 |
| % B.WT | 2.99a | 3.28b | 3.36b | 3.53b | 0.096 | 0.076 |
| g/ kg $BW^{0.75}$ | 56.21a | 63.47b | 67.34c | 70.92c | 1.189 | 0.001 |
| RDMI(g) | 342.92c | 331.38bc | 311.70b | 233.16a | 9.019 | 0.001 |
| % B.WT | 2.73d | 2.35c | 1.90b | 1.40a | 0.057 | 0.001 |
| g/ kg $BW^{0.75}$ | 51.46d | 45.59c | 38.26b | 28.26a | 2.114 | 0.001 |
| CDMI(g) | 31.99a | 130.75b | 235.14c | 346.68d | 4.962 | 0.001 |
| % B.WT | 0.25a | 0.92b | 1.45c | 2.13d | 0.053 | 0.001 |
| g/ kg $BW^{0.75}$ | 4.74a | 17.88b | 29.07c | 42.66d | 0.786 | 0.001 |

$^{abcd}$ Mean values in a row bearing different superscripts differ significantly ($p<0.05$)

**Nutrient Intake**

The mean intake (g/d) of OM, CP, EE, CF is presented in Table 4. $T_3$ and $T_4$ group had significantly ($p<0.05$) higher OMI and CPI when compared to other groups. However, it increased linearly as CFM proportion was increased in the diet. Therefore, as the CFM quantity increased in the diet CP intake was also increased proportionally. But there was no significant difference between the groups for intake of CF. Highest CPI was found in $T_4$ (113.57) due to the higher level of CP in CFM supplemented to meet the recommended requirements of the weight gain (ICAR, 2013) [5]. Therefore, as the CFM quantity supplemented in the diet CP intake was also increased proportionally, Identical outcomes were found and reported by Jaishankar *et al*. (2021) [8] when the CFM quantity in the diet increased and CP intake also increased accordingly. Woyessa *et al*. (2013) [18] noticed addition of dried Vernonia leaves and a sorghum grain mixture increased crude protein intake. Similar trend for crude protein intake across treatment groups was observed by Melese *et al*. (2014) [13] Kebede *et al*. (2020) [11] and Pereira *et al.* (2021) [14]. groups. Similar findings was reported by with Jaishankar *et al*. (2021) [8] who noticed that the crude protein intake through CFM increased linearly with the concentrate supplementation in the diet to meet gain as per ICAR 2013 [5].

**Table 4:** Mean Nutrient intake of experimental Hassan sheep lambs

| Particular | $T_1$ | $T_2$ | $T_3$ | $T_4$ | SEM | P Value |
|---|---|---|---|---|---|---|
| OMI(g/d) | $349.68^{a}$ | $452.36^{b}$ | $543.32^{c}$ | $567.21^{c}$ | 21.06 | 0.001 |
| % B.W | $2.48^{a}$ | $54.44^{ab}$ | $3.07^{bc}$ | $3.28^{c}$ | 0.130 | 0.002 |
| CPI(g/d) | $32.77^{a}$ | $67.68^{b}$ | $92.22^{c}$ | $113.57^{d}$ | 1.975 | 0.010 |
| % B.W | $0.23^{a}$ | $0.40^{b}$ | $0.52^{c}$ | $0.65^{d}$ | 1.974 | 0.028 |
| EEI(g/d) | $8.76^{a}$ | $13.42^{b}$ | $16.87^{c}$ | $19.20^{d}$ | 0.528 | 0.001 |
| % B.W | $0.06^{a}$ | $0.08^{b}$ | $0.09^{c}$ | $0.11^{d}$ | 0.004 | 0.001 |
| CFI(g/d) | $128.35^{b}$ | $118.76^{b}$ | $117.32^{ab}$ | $95.24^{a}$ | 7.733 | 0.048 |
| % B.W | $0.91^{c}$ | $0.70^{b}$ | $0.67^{ab}$ | $0.55^{a}$ | 0.048 | 0.006 |
| NFEI(g/d) | 179.78 | 252.48 | $307.91^{c}$ | $339.19^{c}$ | 10.831 | 0.001 |
| % B.W | $1.27^{a}$ | $1.46^{ab}$ | $1.77^{c}$ | $1.96^{c}$ | 0.660 | 0.001 |

$^{abcd}$ Mean values in a row bearing different superscripts differ significantly ($p<0.05$)

**Digestibility of nutrients**

The average digestibility of nutrients in experimental lambs during metabolic trial is presented in Table 4. The average OM and DM digestibility varied non-significantly between all the treatment groups. Whereas, CP, EE, CF and NFE was statistically significant difference was observed between treatment groups. Digestibility of CP, EE and NFE in $T_1$ group was significantly lower when compared to $T_2$, $T_3$ and $T_4$. But there is no significant difference between $T_2$, $T_3$ and $T_4$. The proportion of roughage intake was gradually decreased whereas the proportion of concentrate intake gradually increased from $T_1$ to$T_4$. Similar results were reported by Jaishankar *et al.* (2021) [8] when sugarcane trash used as a sole roughage source to assess the growth potentiality of lambs. The *in vitro* gas production study also showed linear increase in gas production with increase in proportion of concentrates in the diet. This might be due to availability of better digestible nutrients from concentrates for rumen microbes. Truely digestible organic matter, Partitioning factor, microbial biomass production and efficient microbial biomass synthesis for complete diets increased linearly with increase in the proportion of CFM from 20 to 60 percent in the diet. (Jaishankar *et al.*, 2021a) [8].

**Table 5:** Mean digestibility of nutrients and Nitrogen balance in Hassan sheep lambs

| Digestibility (%) | $T_1$ | $T_2$ | $T_3$ | $T_4$ | SEM | P Value |
|---|---|---|---|---|---|---|
| DM | 61.8±5.8 | 70.4±2.1 | 72.8±2.1 | 73.1±0.4 | 3.14 | 0.073 |
| OM | 82.2±2.7 | 85.4±1.0 | 86.1±0.6 | 85.4±0.2 | 1.473 | 0.281 |
| CP | $54.3±6.9^{a}$ | $75.9±1.9^{b}$ | $78.0±10.9^{b}$ | $76.7±10.9^{b}$ | 3.623 | 0.001 |
| EE | $65.1±8.2^{a}$ | $84.3±1.2^{b}$ | $86.2±0.5^{b}$ | $88.0±8.2^{b}$ | 2.724 | 0.001 |
| CF | $69.4±4.6^{b}$ | $68.7±2.1^{b}$ | $67.9±2.2^{b}$ | $55.0±1.3^{a}$ | 2.858 | 0.001 |
| NFE | $63.7±5.5^{a}$ | $73.2±2.0^{b}$ | $76.26±0.9^{b}$ | $79.8±0.3^{b}$ | 2.968 | 0.001 |
| **Nitrogen Balance** | | | | | | |
| Intake | $5.42^{a}$ | $10.83^{b}$ | $14.76^{c}$ | $18.17^{d}$ | 0.310 | 0.001 |
| Outgo | $3.10^{a}$ | $3.80^{ab}$ | $4.90^{c}$ | $7.52^{d}$ | 0.260 | 0.001 |
| Balance | $2.16^{a}$ | $7.04^{b}$ | $9.86^{c}$ | $10.66^{c}$ | 0.300 | 0.001 |

$^{abcd}$ Mean values in a row bearing different superscripts differ significantly ($p<0.05$)

**Nitrogen balance**

The average N intake by the experimental animals for the treatment groups $T_1$, T -2, $T_3$ and $T_4$ were 5.24, 10.83, 14.76 and 18.17 g/d, respectively, is represented in Table 5. Treatment group$T_3$ and $T_4$ had significantly ($p<0.05$) higher N intake compared to $T_1$ and $T_2$. The average N outgo was 3.10, 3.80, 4.90 and 7.52 g/d for $T_1$, $T_2$, $T_3$ and $T_4$ group respectively. Treatment group $T_3$ and $T_4$ had significantly higher ($p<0.05$) positive N balance. Positive nitrogen balance was noticed in all the treatment groups and increased gradually from the $T_1$ to $T_4$ group due to better CPI and CP digestibility which is mainly due to higher / increased CFM intake. N balance was linearly increased with higher levels of CFM intake that contributed for better body weight gains. Similar reports was observed by Jaishankar *et al*., (2021) [8] when sugarcane trash used as a sole roughage source to assess the growth potentiality of lambs. Chethan *et al*. (2022) [4] when $T_1$ group lambs were fed conventional green fodder (CGF), finger millet straw (FMS) and compounded feed mixture (CFM) at 50:10:40 ratio on DM basis. He noticed FCR (g DMI/ g wt. gain) was 7.9 g /d and was comparable with present study in $T_2$ group which was fed *ad libutum* COFS-29 green fodder along with CFM to gain 50 g/daily gain according to ICAR, (2013) [5].

**Table 6:** Nutritive value and plane of nutrition in Hassan lambs during metabolic trial

| Particular | $T_1$ | $T_2$ | T--3 | T4 | SEM | P Value |
|---|---|---|---|---|---|---|
| DCP % | 4.72 | 10.64 | 12.68 | 14.37 | 0.44 | N/S |
| DOMD % | 76.78 | 79.85 | 80.52 | 79.93 | 1.37 | N/S |
| TDN % | $62.52^{a}$ | $70.92^{b}$ | $73.46^{bc}$ | $73.96^{c}$ | 2.77 | 0.01 |
| DE (MJ/Kg DM) | $11.53^{a}$ | $13.07^{ab}$ | $13.54^{bc}$ | $13.63^{c}$ | 0.51 | 0.03 |
| ME* (MJ/Kg DM) | $9.45^{a}$ | $10.72^{b}$ | $11.10^{bc}$ | $11.18^{c}$ | 0.04 | 0.03 |
| DCP intake (g/d) | $12.15^{a}$ | $35.71^{b}$ | $51.68^{c}$ | $64.66^{d}$ | 2.13 | 0.00 |
| ME intake (MJ/d) | $3.59^{a}$ | $5.18^{b}$ | $6.34^{c}$ | $6.77^{c}$ | 0.31 | 0.001 |
| TDN intake (g) | $237.62^{a}$ | $342.64^{b}$ | $419.84^{c}$ | $448.32^{c}$ | 20.73 | 0.001 |

$^{abcd}$ Mean values in a row bearing different superscripts differ significantly ($p<0.05$)

**Nutritive value of diet**

The nutritive value of the experimental diet is presented in the Table 5. The DCP %, DOMD % and TDN % was 4.75, 10.64, 12.68 and 14.37; 76.78, 79.85, 80.52 and 79.93 ($p>0.05$); 62.52, 70.92, 73.46 and 73.96 respectively for $T_1$, $T_2$, $T_3$ and $T_4$ groups. The average DE (MJ/Kg DM) and ME (MJ/Kg DM) was 11.53, 13.07, 13.54 and 13.63; 9.45, 10.72, 11.10 and 11.18 for $T_1$, $T_2$, $T_3$ and $T_4$ respectively. There was no significant difference ($p<0.05$) between $T_1$, $T_2$; $T_2$, $T_3$; $T_3$, $T_4$. Whereas, $T_1$ and $T_4$ was significantly different ($p<0.05$) from $T_2$ and $T_3$. $T_1$ was significantly different from $T_2$, $T_3$ and $T_4$. However there was no significant difference between $T_2$ and $T_3$; $T_3$ and $T_4$. The average DCP intake (g/d) 12.15, 35.71, 51.68 and 64.66, ME intake (MJ/d) 3.59, 5.18, 6.34 and 6.77; TDN intake was 237.62, 342.64, 419.84 and 448.32 respectively for $T_1$, $T_2$, $T_3$ and $T_4$ respectively. All the parameters significantly ($p<0.05$) varied between all the treatment groups. Similar results were reported as the DCP and ME intake was gradually increased when proportion of CFM in complete diet increased. This was due to better palatability of CFM than roughage and higher DCP and ME content of diet (Jaishankar *et al.*, 2021b) [9].

**Conclusion**

The growth potential of Hassan sheep lambs was 90.63 g/d, observed in the treatment group ($T_4$) supplemented to gain 150 g/d as per ICAR 2013 under intensive system. Higher roughage intake was noticed in T1 (2.73% body weight). Hence, COFS-29 fodder can be used as sole roughage source in sheep lambs. It was concluded and recommended to feed Hassan sheep lambs to achieve 100 g gain per day as per ICAR 2013 under intensive system adopting good management practice for better economic returns.

**References**


1. AOAC. Official methods of analysis. 16th ed. Washington, D.C: Association of Analytical Chemist; c2005.
2. Akinfemi A, Adu OA, Adebiyi OA. Use of white rot-fungi in upgrading maize straw and the resulting impact on chemical composition and in-vitro digestibility. Livest Res Rural Dev. 2009;21(10):162.
3. Bendary MM, Mankarios AT, Mohamed BK, Mousa EEM. Effect of rumen microflora of buffalo and cattle on digestion of some roughage Egypt. J Nutr Feeds. 2002;5(2):69-183.
4. Chethan KP, Gowda NKS, Prabhu TM, Krishnamoorthy P, Dey DK, Giridhar K, *et al*. Nutritional evaluation of hydroponic maize (*Zea mays*) grain sprouts as a Newer Green Feed Resource in Lambs. Indian J Anim Res. 2022;56(4):434-443.
5. Indian Council of Agricultural Research. Nutrient Requirements of Animals - Sheep, Goat and Rabbit (ICAR-NIANP); c2013.
6. Jaishankar N, Ramachandra B, Thirumalesh T, Jagjiwan Ram, Biradar US, Suranagi MD. Utilization of unconventional sugarcane trash as feed in Narisuwarna × kenguri sheep. Int J Appl Pure Sci Agric. 2017;3(6):52-55.
7. Jaishankar N, Ramachandra B, Thirumalesh T, Jagjiwan Ram, Biradar US, Suranagi MD. *In vitro* Rumen Fermentation Kinetics and Microbial Biomass Synthesis of Unconventional Sugarcane Trash and Concentrates Using Cattle Inoculums. Int J Agric Sci. 2018;10(8):5859-5862.
8. Jaishankar N, Thirumalesh T, Ramachandra B. Effect of urea ammoniated sugarcane trash-based diets on performance of Nari Suwarna × Kenguri F1 sheep. Pharma Innov J. 2021;SP-10(11):143-147.
9. Jaishankar N, Thirumalesh T, Ramachandra B. Evaluation of sugarcane trash based complete diets for rumen degradation kinetics and microbial biomass synthesis by *in vitro* gas production technique. Pharma Innov J. 2021;SP -10(11):275-279.
10. Kalyana Chakravarthi Y, Ravindra Reddy Y, Sarjan Rao K, Ravi A, Punyakumari B, Ekambaram B. A Study On Nutritive Value And Chemical Composition of Sorghum Fodder. Int J Sci Environ Technol. 2017;6(1):104-109.
11. Kebede G, Mengistu A, Animut G. Performances of Arsi-Bale Lambs Fed Diets Based on Sugarcane Tops Silage and Hay as a Partial Substitute for Natural Pasture Hay. Ethiop J Agric Sci. 2020;30(3):177-190.
12. Kumari NN, Reddy YR, Blummel M, Nagalakshmi D, Monika T, Reddy BVS, Reddy CR. Growth performance and carcass characteristics of growing ram lambs fed sweet sorghum bagasse-based complete rations varying in roughage-to-concentrate ratios. Trop Anim Health Prod. 2013;45(2):649-655.
13. Melese G, Berhan Tamir, Mengistu Urge. Effect of supplementation with non-conventional feeds on feed intake and body weight change of washera sheep fed

urea-treated finger millet straw. Greener J Agri Sci. 2014;4(2):067-074.
14. Pereira GA, Santos EM de Oliveira, Araújo GGL de, Sá Paulino R, Perazzo AF, de Farias Ramos JP, *et al*. Intake, nutrient digestibility, nitrogen balance, and microbial protein synthesis in sheep fed spineless-cactus silage and fresh spineless cactus. Small Rumin Res. 2021;194(6):106-293.
15. Ram Rajitwad, Anita Chorey, Nilima Darekar, Thakur VR, N.W. Raut. Proximate Characteristics of Fodder Sorghum as Influenced by Varieties and Cutting Management. Int J Curr Microbiol App Sci. 2020;11:3224-3230.
16. Sheoran OP, Tonk DS, Kaushik LS, Hasija RC, Pannu RS. Statistical Software Package for Agricultural Research Workers. Recent Advances in information theory, Statistics & Computer Applications by DS Hooda & RC Hasija Department of Mathematics Statistics, CCS HAU, Hisar (139-143); 1998.
17. Tamir B, Asefa G. Effects of different forms of Acacia saligna leaves inclusion on feed intake, digestibility and body weight gain in lambs fed grass hay basal diet. Anim Feed Sci Technol. 2009;153(1-2):39-47.
18. Woyessa F, Tolera A, Diba D. Feed intake, digestibility and growth performance of Horro lambs fed natural pasture hay supplemented graded level of Vernonia amygdalina leaves and sorghum grain mixture. J Sci Technol Arts. 2013;2(2):30-37.
19. Moges F, Mellesse A, Dessie T. Assessment of village chicken production system and evaluation of the productive and reproductive performance of local chicken ecotype in Bure district, North West Ethiopia. African Journal of Agricultural Research. 2010 Jul 4.