*Indian Journal of Animal Sciences* **86** (3): 329–334, March 2016/Article
https://doi.org/10.56093/ijans.v86i3.56760

# Effect of straw type (*Cajnus cajan* or *Cicer arietinum*) and form of diet on growth, feed efficiency and slaughter performance of weaned Jamunapari goat kids

M K SINGH[1], M K TRIPATHI[2], A K DIXIT[3] and S K SINGH[4]

*Central Institute for Research on Goats, Makhdoom, Uttar Pradesh 281 122 India*

Received: 16 August 2013; Accepted: 7 August 2015

ABSTRACT

An experiment on Jamunapari goat kids (24), 90-day-old was carried out to assess the effect of straw type (*arhar*, *Cajnus cajan* or gram, *Cicer arietinum*) and form of diet (mash or pellet) on growth, feed efficiency and slaughtering performance. Slaughtering performance was assessed at 9 and 12 months age on 3 animals from each group. Two types of complete feed mixtures were prepared using straw and concentrate in 60:40 ratio. One part of each complete feed mixture was converted to pellet form of diet while another part remained as mash. These were randomly allocated to four groups of kids, six in each and fed *ad lib.* The kids under present feeding and management protocol attained live weight 18 to 19 kg at 6 month, 24 to 28 kg at 9 month and 31 to 34 kg at 12 month of age, with average daily gain (ADG) 71 to 84 g during entire growth period. The feed efficiency (kg feed / kg gain) ranged from 14.5 to 21.1 kg. The carcass weight at 9 month was 11.4 to 12.2 kg, whereas at 12 month varied from 15.0 to 16.3 kg and the dressing percent ranged from 54 to 57. Growth, feed efficiency, carcass weight and dressing percent were similar among 4 kid groups and were not different between the 2 straws and diet forms. Study revealed that goats in general and Jamunapari breed in particular could be maintained under stall feeding with diets containing high proportion of crop residues (gram or *arhar* straw). The diets with roughage to concentrate ration 60:40 provided daily gain up to 84 g, with FCR 14 kg and live weight 34 kg at 12 months of age. Appropriate age of slaughter in Jamunapari kids was observed as 9 month because kids at this age have the greater FCR with low cost of feeding. Pellet diet has better economics for commercial kid production. Therefore, it is suggested that Jamunapari goat kids can be maintained under stall feeding conditions on crop residues based feeding systems suitable for rural as well as goat entrepreneur development under urban locations.

**Key words**: Complete feed, Dressing percentage, Feed conversion ratio, Feed efficiency, Jamunapari goat, Slaughter weight, Weight gain

Goats play an important role in income generation, capital storage, employment generation and house hold nutrition. Contribution of goats in livestock GDP was more than 8.5% at constant price of 2004–05. The rapidly increasing demand of goat meat i.e. chevon in domestic and international market has triggered progressive farmers and entrepreneurs for commercial goat production. The extent to which the rural poor will benefit from these changes depends on how goat farming can be integrated into developing markets (Singh and Singh 2012). Grazing based production systems supply about 30 % of the world's production of sheep and goat meat. Goat production in India is based on grazing in pasture lands however, feed resources are decreasing due to shrinkage of pasture and grazing lands (Dixit *et al*. 2012). Feed and fodders quality and quantity are the major constraints in increasing goat productivity and account for more than 60% of goat rearing under Indian farming conditions. Grazing resources are not sufficient to support the productivity of goats causing low reproduction rates, milk yield, kids survivability, weaning and slaughter weights and dressing percentage. Moreover, feeds from common property resources in general are high fiber feeds those are deficient in several essential nutrient for microbial fermentation in rumen. The quality and quantity of forage grass production from grazing land could not be improved because of ever increasing animal population and pressure on decreasing grazing lands. Supplementation of concentrate feeds has become necessity also to make goat farming commercially viable as it promotes rapid growth rate, reduces ruminal methane production, and increases ruminal propionate production, thereby lowering energy losses and contributing to higher overall efficiency of utilization of dietary energy for production functions. The forage based goat feeding with an appropriate level of concentrate and other nutrients provide optimum nutrient

Present address: [1]Principal Scientist (manojnaip @gmail.com), [4]Head (satendra_kumar@yahoo.com), Animal Genetics and Breeding, [2]Principal Scientist (mktripathi@gmail.com), Animal Nutrition, [3]Senior Scientist (aampi2003@yahoo.co.in), Agricultural Economics.

use efficiency for improving animal productivity. In optimizing nutrient synchrony for effective and efficient nutrient utilization for a specified production requiring unique nutrient supply for biotransformation into animal products, conceptualized the technique of complete feed. A complete feed refers to the dietary components of a meal that provide optimally required nutrient in quality and quantity for the desired production level by the specified animal species. This is state of arts developed by the animal nutrition experts for harvesting high levels of animal productivity in a short period of feeding from each animal to the extent of their genetic potential. However, high roughage based complete feed formulations suitable to goat kids feeding for chevon production have not been studied much. The complete feed formulations may contain the locally available cheaper feed components (Raghuvansi *et al*. 2007a,b), in view of availability and the cost in the locality, which are recommended upon limited or lack of grazing resources and suitable under urban locations where higher returns from goat products are expected. Rations with 60 % concentrate were reported economical for goat kid production (Prakash *et al*. 2006, Singh *et al*. 2010). Identification and development of cheaper balanced goat feed mixtures as pellets, mash and blocks based on crop by-products is necessary for enhancing finishing weights and carcass quality and for increasing adoption of supplementary feeds by the goat farmers and the entrepreneurs for commercial goat meat production. Jamunapari is a large size dual purpose goat breed and in great demand in different regions for commercial goat meat production. Therefore, present study was planned to evaluate the performance of 2 most widely and commonly used straws for goat feeding in 2 major diet forms. Therefore, present study aim was to assess the effect of roughage (60 %), type (*arhar* on gram straw) and form (mash or pellet) of diet on performance, feed efficiency and slaughtering performance of Jamunapari weaning kids.

## MATERIALS AND METHODS

The experiment was conducted at the Central Institute for Research on Goats, Makhdoom located at 27°10'N latitude and 75° 28'E longitude and 169 m above sea level. The climate is hot and semi-arid.

*Animals, housing and feeding management:* Weaned male Jamunapari kids (24) of 3 months age were randomly divided into 4 equal groups of 6 each. Kids were penned in well-ventilated enclosures and fed individually a composite diet consisting of 60:40 roughage to concentrate ratio. The nutrient requirement of animals was met out as per recommendations (ICAR 1998).The kids were reared up to the age of 9 months; thereafter three animals from each group were slaughtered at 9 months of age while other 3 animals from each group were maintained up to 12 months of age and slaughtered.

Two types of composite feed mixtures were prepared using *arhar* (*Cajnus cajan*) or gram (*Cicer arietinum*) straw with concentrate in 60:40 ratio. One portion of each composite feed mixture was processed to formulate pellet (6 to 8 mm diameter and 30 to 40 mm length) using a pelleting machine. Each diet form namely *arhar* straw mash (AM), *arhar* straw pellet (AP), gram straw mash (GM), gram straw pellet (GP) was fed *ad lib.* to 1 of the 4 animal groups. Water was available *ad lib*. Kids were offered diet in an excess of 10 % of previous days intake and daily records of feed intake were maintained during the experiment.

*Growth performance:* Goats were weighed at monthly intervals to determine the pattern of growth until animal attained the age of 270 and 360 days and the change in live weight was used to assess pattern of growth, daily gain and feed efficiency.

*Slaughter procedure:* Three representative animals from each group were slaughtered after 180 and 270 days of feeding as the animal attained age of 270 and 360 days respectively. Kids of the four groups were fasted for 18 h, allowed free access to water; BW was recorded prior to slaughtering (PSW) and the animals were slaughtered in experimental abattoir by the Halal method. After slaughter, the head was removed at the atlanto-occipital joint, and fore and hind feet were removed at the carpal and tarsal joint, respectively. The animals were suspended by the hind legs after partial skinning, laid on their back on the floor for further skinning. Carcass and non-carcass (head, skin, liver, lungs, heart, kidney, spleen, digestive tract, gall bladder, pancreas, testes, caul and kidney fat) components were separated and weighed immediately after slaughter. Lungs, trachea and heart were weighed at one piece and designated as pluck. The gut fill digesta weight was calculated as the difference between the weights of full and empty digestive tract. The empty live weight (ELW) was computed as the difference between PSW and gut fill. After skinning and evisceration, the carcass was divided into four and hindquarter at the intersection of $12^{th}$ and $13^{th}$ vertebrae. The loin eye area ($CM^2$) was measured by a planimeter on the cut surface of *longissimus dorsi* muscle at the interface of $12^{th}$ and $13^{th}$ ribs on both side of the carcass. Thereafter the carcass was split along the mid line and left half was disjoined as per the ISI (1963) into standard cuts viz. leg, loin, rack, neck and shoulder, and breast and fore shank.

*Statistical analysis:* The observations of live weight gain, average daily gain, feed intake and feed efficiency were subjected to statistical significance test using analysis of variance procedure following general linear mathematical model as: $Y_{ijk} = \mu + T_i + e_{ij,}$ where, $Y_{ijk}$, observation mean; $\mu$, general mean; $T_i$, effect of $i^{th}$ treatment (i = 1, 4; AM AP, GM and GP), $e_{ij}$, random error. While the diet form (mash or pellet) and straw type (*arhar* or gram) were tested using students t test procedure. The effect of slaughter age and diet on carcass traits were analyzed using factorial arrangements with diet (AM, AP, GM, GP) and slaughter age (270 and 360 days) as factor of multivariate procedure of general linear mathematical model as: $Y_{ijkl} = \mu + T_i + A_j + (T \times A)_{ij} + e_{ijk,}$ where, $Y_{ijkl}$,observation mean; $\mu$, general mean; $T_i$, effect of $i^{th}$ treatment (i, 1, 4; AM AP, GM and GP); $A_j$,

effect of $j^{th}$ age (j = 1, 2;) + $(T\times A)_{ij}$, interaction between $i^{th}$ treatment and $j^{th}$ age and $e_{ijk}$, random error. All statistical analysis was performed using statistical (SPSS base 16 software).

## RESULTS AND DISCUSSION

*Growth performance:* The initial live weight of kids at 90 days of age was similar among 4 kid groups, which ranged from 12.5 to 13.3 kg. The live weight of experimental animals ranged from 18.0 to 19.0 kg at 6 months, 24.0 to 27.8 kg at 9 months and 31.3 to 34.3 kg at 12 months of age which was not different among 4 kid groups (Table 1). The live weight of kids improved linearly with increasing days of experimental feeding (Fig. 1). The live weight gain during each 90 day feeding from 90 days of age to 360 days of age varied from 5.1 to 10.2 kg, however live weight gains were similar among kid groups during respective periods of growth. There was a trend of increased live weight gain during 181 to 270 days of age (P=0.078) and 271 to 360 days of age (P=0.090) in comparison to growth occurred during 90 to 180 days of age. Average daily gain of the kids was also not different among four groups during different periods of feeding. Feed intake was highest (P=0.020) in kid groups fed *arhar* straw based mash diet during 91 to 180 days of feeding, while other three groups had similar feed intake. Feed conversion ratio (FCR, kg feed/kg gain) was similar among four kid groups fed four types of diets. The mean FCR during entire feeding ranged from 15.8 to 21.1 kg. The FCR increased with progress in feeding period with age of kids showing that Jamunapari kids have higher growth potential that occurred up to one year of age. However, feed efficiency decrease after 9 months of age due to growth is chiefly accompanied by the fat deposition and not due to muscular development.

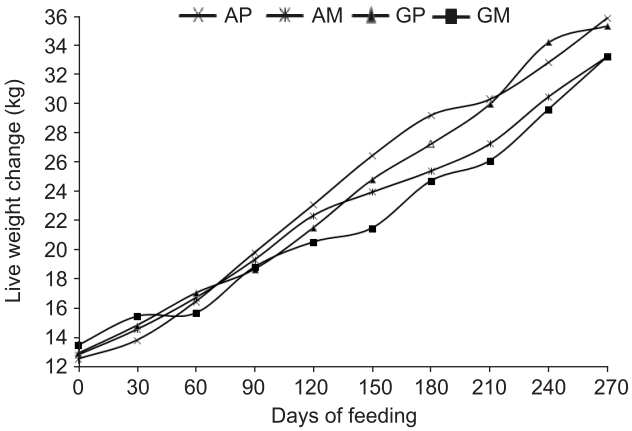


Fig. 1. Live weight change of kids during experimental feeding with a fixed roughage (60) and concentrate (40) ratio. AP, *arhar* straw base pellet; AM, *arhar* straw base mash; GP, gram straw base pellet; GM, gram straw base mash.

The effect of type of straw (*arhar* or gram) and form of diet (mash or pellet) did not differ significantly among each other with respect to kids live weight and average daily gain (ADG), feed intake and feed conversion ratio. The mean ADG was 77.7 and 75.1 g; and FCR 17.8 and 16.9 kg between *arhar* and gram straw diets respectively (Table 1). Similarly, diet type also did not affect the performance

Table 1. Performance of Jamunapari kids fed *arhar* or gram straw based diets with a ratio of roughage (60) and concentrate (40)

| Attribute (s) | Diet* | | | | SEM | p-value |
|---|---|---|---|---|---|---|
| | AP | AM | GP | GM | | |
| Live weight (kg) | | | | | | |
| Initial (90 day age) | 12.5 | 12.75 | 12.83 | 13.33 | 0.348 | 0.877 |
| 180 d feeding (270 d age) | 27.82 | 24.78 | 25.87 | 24.05 | 0.769 | 0.351 |
| 270 d feeding (360 d age) | 33.7 | 31.3 | 33.2 | 34.27 | 1.398 | 0.918 |
| Live weight gain (kg) | | | | | | |
| 91-180 d feeding | 6.62 | 5.92 | 5.17 | 5.23 | 0.339 | 0.411 |
| 181-270 d feeding | 8.70 | 6.12 | 7.87 | 5.48 | 0.508 | 0.078 |
| 271-360 d feeding | 7.47 | 7.63 | 7.93 | 9.42 | 0.792 | 0.090 |
| Average daily gain (g) | | | | | | |
| 91-180 d feeding | 73.5 | 65.7 | 57.4 | 58.1 | 3.766 | 0.411 |
| 181-270 d feeding | 96.7 | 68.0 | 87.4 | 60.9 | 5.647 | 0.078 |
| 271-360 d feeding | 83.0 | 84.8 | 88.2 | 104.5 | 8.796 | 0.090 |
| Mean 91-360 d feeding | 84.0 | 71.3 | 75.7 | 74.5 | 2.557 | 0.355 |
| Feed intake (kg) | | | | | | |
| 91-180 d feeding | 67.7 | 100.4 | 63.3 | 71.9 | 4.897 | 0.020 |
| 181-270 d feeding | 114.8 | 130.1 | 113.8 | 117.2 | 3.583 | 0.358 |
| 271-360 d feeding | 169.7 | 175.0 | 182.5 | 172.0 | 4.259 | 0.790 |
| Feed conversion ratio (kg feed/ kg gain) | | | | | | |
| 91-180 d feeding | 10.3 | 20.4 | 12.6 | 14.3 | 1.565 | 0.125 |
| 181-270 d feeding | 14.7 | 23.1 | 16.0 | 25.1 | 1.832 | 0.107 |
| 271-360 d feeding | 23.3 | 23.3 | 25.6 | 14.4 | 1.954 | 0.181 |
| Mean 91-360 d feeding | 14.5 | 21.1 | 15.8 | 18.0 | 1.015 | 0.100 |

*AP, *arhar* straw pellet; AM, *arhar* straw mash; GP, gram straw pellet; GM, gram straw mash.

attributes of kids, the ADG was 79.9 and 72.9 g, and FCR 15.2 and 19.6 kg between pellet and mash diets respectively. Kids fed pelleted diet consumed 4.4 kg less feed accounting a 22.4 % reduced feed intake for each kg live weight gain than the kids fed mash diet though observed values did not differ significantly.

Daily gain and FCR of the kids under 4 groups were in agreement and is within the reported range of variation for Indian goat kids (Dutta *et al*. 2009, Sahoo and Walli 2008 and Singh *et al.* 2010). Sahoo and Walli (2008) reported daily gain 41 to 72g in growing kid fed diets with R:C 50:50 with varying levels of rumen un-degradable proteins, while Dutta *et al.* (2009) reported ADG 48 to 55 g in kids fed diets with varying energy and protein levels. A growth rate of 19.4 to 108.2 g/h/d was obtained in Beetal weaned kids from 91 to 180 days of age under varying feeding regimes (Parathasarthy *et al*. 1983). The average daily gain was not different among 4 groups of kids due to similar level of feeding accompanied by roughage to concentrate ratio of 60:40. Since kids were fed a high roughage diet in present study, therefore the average daily of 70 to 80 g seems optimum. Similar growth rate has been reported in Jamunapari goats fed. Ration (60% *Cajanus cajan* straw based ration) with total digestible nitrogen (TDN) 55% and CP 12% was found economical to have 53.6 g ADG with FCE of 9.9% in weaned Barbari kids (Prakash *et al*. 2006). Earlier, Rekhate *et al*. (2004) also found that daily live weight gain was considerably higher in Indian goats fed gram straw based pellets and fulfilled the requirement of goats growing at 108 g per day under stall fed condition. Agnihotri *et al.* (2006) reported that different level of protein and energy in the diet did not influence slaughter weight, body and carcass measurement. Level of concentrate (50%, 70% and 90%) in the diet also did not influence carcass traits (Ryan *et al*. 2007). Kids fed high energy diet were however observed to have higher dissected body fat (Abdullah and Musallam 2007). Similar ADG and FCE in kids were reported (Dutta *et al.* 2009), when weaned kids were fed with different energy-protein levels in the diet. Although there was increasing tendency of ADG and FCE reported due to higher energy and protein levels in the rations (Prakash *et al*. 2006). However, Saikia *et al.* (1995) reported an increase in dry matter intake in small ruminants, particularly goat, with increase dietary energy levels irrespective of protein levels increased average daily gain and feed conversion efficiency. Since, concentrate level was similar, gram and *arhar* straw used in complete feed was of similar quality, moreover feed intake was also similar among four kids, between type of straw, and also between diet types hence differences among kids groups, between type of straw and, diet type were not observed for ADG and FCR. However, ADG and FCR of kid in present study were within the reported range of variations for Indian goat kids (Dutta *et al.* 2009, Prakash *et al.* 2006, Saikia *et al.* 1995, Parathasarthy *et al*. 1983 and 1984). Forage to concentrate ratio was invariably kept at 60:40, which was required for greater intake and digestibility of dry matter (DM), organic matter (OM) and crude protein (CP) (Haddad

Table 2.Slaughter performance of Jamunapari kids fed *arhar* or gram straw based diets with a ratio of roughage (60) and concentrate (40) at 270 and 360 d of age

| Attribute (s) | Diet* | | | | Mean | p-value |
|---|---|---|---|---|---|---|
| | AP | AM | GP | GM | | |
| Slaughter weight | | | | | | |
| 270 d age | 25.8 | 24.6 | 24.9 | 24.8 | 25.02 | T=0.239 |
| 360 d age | 32.6 | 31.7 | 33.3 | 32.1 | 32.39 | Age <0.001 |
| Mean | 29.2 | 28.1 | 29.1 | 28.4 | 28.7 | T*A 0.995 |
| Empty weight (kg) | | | | | | |
| 270 d age | 22.0 | 20.2 | 21.6 | 21.5 | 21.33 | T=0.0.027 |
| 360 d age | 28.8 | 27.0 | 29.1 | 28.1 | 28.27 | Age=<0.001 |
| Mean | 25.4 | 23.6 | 25.4 | 24.8 | 24.8 | T*A= 0.997 |
| Carcass weight (kg) | | | | | | |
| 270 d age | 12.2 | 11.4 | 11.8 | 12.0 | 11.83 | T=0.187 |
| 360 d age | 16.3 | 15.0 | 16.3 | 15.3 | 15.71 | Age= 0.001 |
| Mean | 14.3 | 13.2 | 14.0 | 13.6 | 13.77 | T*A= 0.977 |
| Dressing percent (on live weight basis) | | | | | | |
| 270 d age | 47.6 | 45.8 | 47.2 | 48.2 | 47.17 | T=0.285 |
| 360 d age | 50.5 | 47.2 | 49.0 | 47.6 | 48.58 | Age= 0.147 |
| Mean | 49.0 | 46.5 | 48.1 | 47.9 | 47.87 | T*A= 0.714 |
| Dressing percent (on empty weight basis) | | | | | | |
| 270 d age | 55.4 | 55.4 | 54.6 | 55.3 | 55.18 | T=0.564 |
| 360 d age | 56.7 | 55.6 | 56.0 | 54.4 | 55.67 | Age = 0.440 |
| Mean | 56.0 | 55.5 | 55.3 | 54.9 | 55.43 | T*A =0.824 |

*AP, *arhar* straw pellet; AM, *arhar* straw mash; GP, gram straw pellet; GM, gram straw mash.

2005). Adequate ruminal energy supply coupled with an appropriate amount of ruminally available nitrogen promotes microbial nitrogen synthesis and efficiency (Henning *et al.* 1993). DM intake between mash and pellet groups was similar, however physical nature of the feed is known to affect post ingestion phenomenon (Raghuvansi *et al.* 2007a). Goats are very selective towards nutritious feeds and feed processing in the form of pellet did not provide options to make selection. Although, selection options were available with mash fed kids, however straw was of good quality therefore influence of selection on intake was not evident in present study. Since both *arhar* and gram straw contains crude protein more than 8.0 % hence rumen fermentation was not effected due to selection toward concentrate or straw. It is well established that efficient microbial growth in the rumen require a balanced supply of nitrogen (amino acids and ammonia) and energy and diets containing less than 8% CP limits microbial growth in the rumen (Beever 1993). The animals of the present study were provided feed once in the morning, so an even supply of energy and protein maintained; therefore nutrient intake and performance was not affected by the type of straw and form of diet. Present findings corroborate the findings of Raghuvansi *et al.* (2007 b) and Samanta *et al.* (2003) when complete feed were fed to sheep/ goats.

*Slaughter performance:* Slaughter performance of kids in four groups at 270 and 360 days of age is presented in Table 2. The live weight of kids was similar at slaughter, while age of slaughter had the significant ($P<0.001$) effect on slaughter weight. This was due to normal physiological effect demonstrating higher live weight at later days of age during growing period. The empty live weight was different ($P=0.027$) among four kids groups, which was higher in kids fed pelleted diets, Carcass weight ranged from 11.4 to 12.2 kg at 9 months of age, 15.0 to 16.3 kg at 12 months of age, with mean 13.2 to 14.3 kg among kid groups, which was statistically similar. Dressing percent in live weight as well as on empty weight basis was similar among kids groups and was also not different between kids slaughtered at 9 and 12 months of age. The mean dressing percent was 47.2 and 55.2 percent respectively on live weight and empty weight basis at 9 months of age, whereas it was 48.6 and 55.7 respectively at 12 months of age.

Type of straw (*arhar* or *gram*) and form of diet (mash or pellet) did not affect the slaughter, empty and carcass weights, and dressing percent of the kids. The carcass weight and dressing percent 13.7 and 13.8 kg, 47.75 and 47.99 percent respectively in *arhar* and gram fed based feeding. However carcass weight was 14.4 and 13.4 kg, and dressing percent was 48.56 and 47.19 respectively in pellet and mash form of diet fed kids. Although not significantly different but an improvement of 5.5% in carcass weight and 2.9% in dressing (on live weight basis) was observed in pellet in comparison to mash form of diet fed kids.

Carcass weight and dressing percent of the kids under different groups is in agreement with the findings of Parathasarthy *et al.* (1984), who reported carcass weight 12 to 13 kg and dressing 48 to 51 percent in male kids weaned at 2 to 3 month age and fed under feedlot system of management. Similarly, Dutta *et al.* (2009) reported similar dressing percent varying from 47 to 57 percent in goat kids fed for 120 days with varying levels of protein in diet. The dressing percent of the meat animals in general is not affected by the age, however plan of nutrition has marked effect on dressed meat yield (Tripathi and Karim 2011). Since, nutrient densities were similar among the diets fed to 4 groups of kids hence differences in carcass weight and dressing percent were not expected.

*Economics of kid production:* The feeding cost of live weight gain and dressed meat production was worked out considering the current prices of each kg straw @ ₹ 3.50 and of concentrate @ ₹ 15.00. The cost of feeding varied from ₹ 82.8 to 137.4 at 6 months of age, ₹ 106.0 to 173.3 at 9 months of age and ₹ 147.9 to 186.4 at 12 months of age for each kg live weight gain under four dietary regimens. Similarly, cost of each kg dressed meat ranged from ₹ 192.9 to 313.3 at 9 months of age and ₹ 271.9 to 334.1 at 12 months of age. The pellet diet had the lower cost of feeding per unit live weight gain and dressed meat production. The slaughter of animal at 9 months of age incurring a low cost of feeding for kid production than slaughtered at 12 months of age due to better FCR at 9 months of age. It is well established that with increase in age beyond active growth phase, the feed efficiency for growth reduces due to changes in tissue accretion pattern; later age favors more fat deposition in place of muscular growth and development (Karim *et al.* 2008). The fat deposition is a more energy expensive process than cellular development which reduced feed conversion efficiency. Reduced cost of feeding in pellet diets is due to changes in rumen fermentation pattern, pellet diets increases propionate production favoring glucose production for energy yield (Huyen *et al.* 2012), which is efficiently utilized for cellular growth and development.

It is concluded that Jamunapari goat kids can be maintained under stall feeding with diets containing high proportion of crop residues (gram or *arhar* straw). The diets with roughage to concentrate ration 60:40 provided daily gain 71 to 84 g, with FCR 14 to 21 kg providing live weight 31 to 34 kg at 12 months of age. The dressing percent under experimental protocol was 55 percent. Slaughter of kids at 9 month of age is more economical due to better FCR at 9 months of age, incurring a low cost of feeding for kid's production than slaughtered at 12 months of age. Pellet diet improved FCR and reduced cost of feeding over mash diet. Therefore, Jamunapari goat kids can be maintained under stall feeding conditions on crop residues based feeding systems suitable for rural as well as goat entrepreneur development under urban locations.

ACKNOWLEDGEMENT

Authors are thankful to Director, CIRG, Makhdoom for providing guidance and technical support to conduct experiment.

REFERENCES

Abdullah A Y and Musallam H S. 2007. Effect of different levels of energy on carcass composition and meat quality of lame black goat kids. *Livestock Science* **107**: 70–80.

Agnihotri M K, Rajkumar V and Dutta T K. 2006. Effect of feeding complete rations with variable protein and energy levels prepared using by-products of pulses and oilseeds on carcass characteristics, meat and meat ball quality of goats. *Asian Australasian Journal of Animal Sciences* **19**: 1437–49.

Beever D E. 1993. Rumen function. *Quantitative Aspects of Ruminant Digestion and Metabolism*. (Eds) Forbes J M and France J M. pp. 187–215. CAB International, Oxon.

Dixit A K, Singh M K, Reddy B S and Manohar N S. 2012. Potential of wastelands for mixed farming system in India. *Range Management and Agro-forestry* **33** (2): 118–22.

Dutta T K, Agnihotri M K, Sahoo P K, Rajkumar V and Das A K. 2009. Effect of different protein–energy ratio in pulse by-products and residue based pelleted feeds on growth, rumen fermentation, carcass and sausage quality in Barbari kids. *Small Ruminant Research* **85**: 34–41.

Haddad S G. 2005. Effect of dietary forage: concentrate ratio on growth performance and carcass characteristics of growing Baladi kids. *Small Ruminant Research* **57**: 43–49.

Henning P H, Steyn D G and Meissner H H. 1993. Effect of synchronization of energy and nitrogen supply on ruminal characteristics and microbial growth. *Journal of Animal Science* **71**: 2516–28.

Huyen N T, Wanapat M and Navanukraw C. 2012. Effect of Mulberry leaf pellet (MUP) supplementation on rumen fermentation and nutrient digestibility in beef cattle fed on rice straw-based diets. *Animal Feed Science and Technology* **175**: 8–15.

Karim S A, Tripathi M K,Chaturvedi O H and Shinde A K. 2008. *Small Ruminant Production in India: Strategies for Enhancing.* 1st edn, p. 618. Satish Serial Publishing House, Delhi, India.

Parthasarthy M, Singh D and Rawat P S. 1983. Effect of supplementation on the performance weaner kids. *Indian Journal of Animal Sciences* **53**: 671–72.

Parthasarthy M, Singh D and Rawat P S. 1984. Performance of feedlot kids on different dietary regimen. *Indian Journal of Animal Sciences* **54**: 130–31.

Prakash B, Dutta T K and Siddiqui I A. 2006. Effect of plane of nutrition on nutrient utilization and performance of Barbari kids. *Indian Journal of Animal Nutrition* **23**: 29–33.

Raghuvansi S K S, Prasad R, Mishra A S, Chaturevedi O H, Tripathi M K, Misra A K, Saraswat B L and Jakhmola R C. 2007a. Intake, performance, nutrient utilisation, rumen fermentation and rumen microbial enzymes of lambs maintained on complete feed blocks or grazing and supplementation. *Animal* (Cambridge) **1**: 221–26.

Raghuvansi S K S, Tripathi M K, Mishra A S, Chaturevedi, O H, Prasad R, Saraswat B L and Jakhmola R C. 2007b. Feed digestion, rumen fermentation and blood-biochemical constituents of Malpura rams on feeding of tree leaves included pearl millet stover based complete feed block diets. *Small Ruminant Research* **71**: 21–30.

Rekhate D H, Madavi V B, Dhok A P and Patil J M. 2004. Evaluation of arhar and gram straw based pelleted complete feed in goat. *Indian Journal of Animal Nutrition* **21**: 257–60.

Ryan S M, Unruh J A, Corrigan M E, Drouillard J S and Seyfert M. 2007. Effect of concentrate level on carcass traits of Boer crossbred goats. *Small Ruminant Research* **73**: 67–76.

Sahoo B and Walli T K. 2008. Effects of formaldehyde treated mustard cake and molasses supplementation on nutrient utilization, microbial protein supply and feed efficiency in growing kids. *Animal Feed Science and Technology* **142**: 220–30.

Saikia G, Baruah K K, Buragohain S C, Saikia B N and Pathak N N. 1995. Feed intake, utilization of nutrients and growth of Assamese × Beetal fed three levels of energy. *Small Ruminant Research* **15**: 279–82.

Samanta A K, Singh K K, Das M M, Maity S B and Kundu S S. 2003. Effect of complete feed block on nutrient utilization and rumen fermentation in Barbari goats. *Small Ruminant Research* **48**: 95–102.

Singh M K, Dutta T K, Sharma R B, Das, A K and Singh N P. 2010. Evaluation of growth, feed conservation efficiency and carcass traits of Jamunapari goats under intensive feeding system. *Indian Journal of Animal Sciences* **80**: 382–84.

Singh S K and Singh M K. 2012. Genetic Improvement of Small Ruminants Germplasm: Challenges and Opportunities. *National Seminar on Future Challenges and Opportunities to Improve Health and Production of Small Ruminants.* Pp. 11–25. 22–23 December 2012, CIRG, Makhdoom, Mathura.

Tripathi M K and Karim S A. 2011. Effect of yeast culture supplementation on live weight change, rumen fermentation, ciliate protozoa population, microbial hydrolytic enzymes status and slaughtering performance of growing lambs. *Livestock Science* **135**: 17–25.