REVIEW ARTICLE Agricultural Reviews, Volume 41 Issue 3: 285-290 (September 2020)

Significance of Feeding Practices for Small Ruminants: A Review

A. A. Khaskheli[1], M. I. Khaskheli[2], A.J. Khaskheli[3], A.A. Khaskheli[4]

10.18805/ag.R-149

ABSTRACT

Current study was carried in order to understand the significance of feeding practices for small ruminants. In this regards a detailed review of already conducted researches was performance, whereby obtained facts were found to be much interesting and valuable. It was indicated that the profitable small ruminants farming depends upon feeding practices because the feed cost about 70% in farming. Small ruminants are often offered grazing on summer and winter fodders for maintenance and production requirements. However, commercial production demands a change in feeding practice with a trend for more efficient utilization of scarce feed resources. It was further stated that goats spent more time on eating than sheep, while ruminating time remain higher in sheep than goats. Drinking time appears different among these species. Goats spent more time on playing and resting than sheep. Moreover, in extensive, semi-intensive and intensive feeding systems, dry matter intake was noticed higher in sheep than goats. Crude protein intake was reported significantly higher in sheep than goats fed intensively. NDF and ADF intake was higher in goats than sheep. Average daily weight gain was higher in sheep than goats on the extensive system followed by the semi-intensive system. Feed efficiency was similar in both species, while the cost of gain per kg was more economical in goats compared sheep. In conclusion both species performed better on extensive feeding system than the other systems. It might be because of natural grazing behavior.

Key words: Feeding, Goat, Performance, Production, Sheep.

Small ruminants are very important for the livelihood of peoples inhibiting in the regions, where buffalo and cattle production is not suitable. In rural population small ruminants have significant contribution, including meat, milk, hair, wool and skins. These animals are slaughtered regularly for social and religious occasions and act as constant source of income for households (Daskiran *et al.* 2010). The socio-economic importance of small ruminants has extensively been recognized. There are several factors though potentially contribute such breed ignorance, inappropriate management system and poor feeding practice. Small ruminants are still traditionally reared in most of countries and that hinders animal productivity and considerably impairs the income of small ruminants' farmers (Devandera, 2001).

In addition to that feeding behavior can also influence the efficiency and cost of rearing the animals. Feeding rate, feeding duration, feed intake, feeding frequency and activity level (Stephen, 2008) varies with the species and contribute to animals' performance production. Feed intake and growth rate are partially different due to genetic variation and may be included in selection criteria. There are many factors influencing maintenance and growth. Among those feeding variability may have a large role in animals' life (Cammack *et al.*, 2005). The production quality of small ruminants can be manipulated through feeding practice (Arsenos *et al*. 2002). The young animals on high concentrate diets perform better and put higher daily weight gain, dressing percentage and carcass quality compared to forage feeding. The concentrates feeding reduces slaughter age, increases carcass quality and meat yield. The performance of lambs and kids can be improved by appropriate mixture of fodders and concentrates (Johnson *et al.* 2005).

[1]Department of Animal Nutrition, Sindh Agriculture University, Tando Jam, Pakistan.
[2]Department of Plant Protection, Sindh Agriculture University, Tando Jam, Pakistan.
[3]Department of Biotechnology, Sindh Agriculture University, Tando Jam, Pakistan.
[4]Department of Poultry Husbandry, Sindh Agriculture University, Tando Jam, Pakistan.

Corresponding Author: A.A. Khaskheli, Department of Animal Nutrition, Sindh Agriculture University, Tando Jam, Pakistan. Email: khaskhelias@gmail.com

How to cite this article: Khaskheli, A.A., Khaskheli, M.I., Khaskheli, A.J. and Khaskheli, A.A. (2020). Significance of Feeding Practices for Small Ruminants: A Review. Agricultural Reviews. 41(3): 285-290.

Submitted: 20-04-2020 **Accepted:** 10-08-2020 **Published:** 12-09-2020

From above given facts it seems clear that feeding practice possess significant role in the life of mall ruminants. Keeping in view these realities, current study was planned in order investigate different practices for small ruminants worldwide and their possible impacts on the animals' life including behavior, performance and production.

Present review was conducted in order to evaluate the significance of feeding practices for small ruminants, worldwide. Study included six main objectives and detailed literatures were reviewed in that regards. Under first objective the influence of feeding practices on behavior of small ruminants was reviewed, in the second objective influence of feeding practices on diet intake of small ruminants was studied, under third objective influence of feeding practices on performance of small ruminants was

focused, under fourth objective influence of feeding practices on nutrients digestibility of small ruminants was examined, under fifth objective influence of feeding practices on feed efficiency of small ruminants was assessed, however under sixth objective the main focus was on the influence of feeding practices on economics. Results regarding each objective are given in their subsequent sections.

Influence of feeding practices on behavior of small ruminants

Many studies have been conducted on the influence feeding practices on the behavior of small ruminants. In a study, Domingue *et al*. (1991) determined the eating and ruminating time in goats and sheep. They offered chaffed Lucerne hay (*Medicago sativa*) to both species and reported higher eating time and lower ruminating time in goats than in sheep in a period of twenty four hours the reason might be specie difference as goats are browser while sheep are grazer. Mahmut *et al*. (2005) conducted research on (7) seven male Awassi sheep and (7) seven male Shami goats and fed with a diet having 2503 Kcal ME and155 g crude protein per kilogram. The recorded activities were eating, ruminating, drinking, resting, standing and playing. They claimed goats showed less drinking and standing but higher playing and resting behavior than sheep. Similar findings were reported by Haddad and Obeidat, (2007) who conducted a research trial on feeding behavior and performance of sheep and goats fed a concentrate finishing diet having crude protein 16% and ME 2.85 Mcal per kg dry matter. The eating and ruminating times were found to be significantly in kids than those in lambs.

Ramli *et al.* (2005) reported that goats exhibited eating behavior between 70-80% during the day. However, goats ate 5-6 hours per day and ate more meals per day than sheep. They also found that goats ate more meals than sheep both during the day and at night. Goats spent more total time eating and eat longer during the day than sheep. Goats and sheep spend the same amount of time eating during the night. The goats ate more slowly than sheep due to selective grazing behavior Solanki, (1994) conducted a trial in semi-arid region of India on gazing and feeding behavior of goats. He found that goats selectively grazed in a diurnal pattern with two main peaks, consumed more grasses before noon and more shrubs and bushes in the evening. Although no difference was seen in eating rate but bite size was larger when consuming thorny bushes compared to grasses.

Influence of feeding practices on diet intake of small ruminants

The diet intake can be greatly affected by feeding practice. In this regards many studies have carried out. In a study Salem *et al.* (2005) claimed that voluntary intake of sheep and goats are different on different foliage species, while feeding *Schinus, Chorissia speciosa*, *Chorissia* and *Eucalyptus mole. Cassia fistula* intake was better in sheep than goats on body weight basis, while significantly better intake was found in goats than sheep with *Eucalyptus camaldulensis, Schinus molle* and *Chorissia speciosa.* Trived *et al*. (2005) fed four species of tree fodders fibrious in nature *i.e. Ficus roxburghii*, *Garuga pinnata Bauhinia purpurea* and *Artocarpus lakoocha* to female goats. Higher dry matter intake was found on Artocarpus *lakoocha* 432 g/d while on *Garuga pinnata,* 428 g/d *Bauhinia purpurea* 342 g/d or *Ficus roxburghii* 306 g/day. They concluded that the voluntary intake of sheep and goat varied according to feed offered because sheep and goats have different feeding behavior, preference and eating mood. In another study Aregheore, (1996) reported dry matter intake of goats on groundnut shell 0.63kg, maize cob 0.58kg and cassava peel 0.83kg while in sheep 0.79, 0.70, 0.83 kg DM/kg $^{W0.75}$ respectively. Whereas same intake was observed on *Acacia cynophula* based diet in both species ie 84.9 and 84.4g DM/Kg $^{W0.75}$. Moujahed *et al.* (2005) found no difference in dry matter intake between sheep and goats when fed a diet of concentrate and barley hay. Intake in both species varied due to eating method and diet preference. Gregoirea *et al.* (1996) studied the effect of different protein supplements in Angora female kids under four commercial farms on the growth, feed conversion, mohair production, fiber characteristics and blood parameters. Sixty four weaned angora kids from 12-50 week of age were selected and fed diets based on hay and a concentrate mixture of corn and barely. These diets were supplemented with either soybeen, soybeen and protected methonine, hering meal and corn gluten meal. They observed similar intake on offered diets while goats consumed 6.1 kg more hay on feed contains herring meal than those fed the soyben-Mepron (soyben with feed additive composed methonine) diets.

Influence of feeding practices on performance of small ruminants

Significant effect of feeding practice on the overall performance of small ruminant occurs and that has been confirmed by many researchers. In a study, Turner *et al.* (2005) studied the effect of high forage diets of lespedeza or alfalfa hay on the performance and blood parameters of goats. They fed 18 bucks of 6 months lespedza or alfalfa hay *ad libitum* and reported that average daily gain was better on alfalfa in young goats when fed lespedeza cuneata (103 vs 56 g/d). Wildeus *et al.* (2007) fed a forage diet of alfalfa hay (*Medicago sativa*) *ad libitum* to St. Croix, Katahdin and Barbados Blackbelly breeds. They found that daily gain was not different between Katahdin and St.Croix (131g/day vs 117g/day) but both breeds were significantly different ($P<0.05$) than Barbados black belly 87 g/day.

Salim *et al.* (2002) also reported better performance and higher daily weight gain in sheep and goats, while evaluating the effect of concentrate supplementation on intake and growth performance of sheep and goats under grazing conditions. The animals were grazed in the field 7 hours daily and supplemented with wheat bran, rice polish and soyabean meal. They concluded that supplemented feeding of sheep and goats results in better live weight gain than un-supplemented feeding. Similarly, Kabir *et al.* (2002)

reported that the supplement feeding has positive affect on growth and reproductive performance of sheep and goats, while studying the effect of concentrate mixture of (wheat bran,rice polish and soyabean meal) 350 g/d on weight gain and reproductive performance of goats and sheep under grazing conditions. Patel *et al.* (2004) conducted research on twenty four farms with weaned lambs, 12 each of Marwari and Patanwadi breeds. The animals were randomly divided into two dietary treatments *i.e*. T_1-conventional composed maize 38.00, ground nut cake 25.00, rice polish 24.00, jaggery solution 10.00 (solution prepared from sugar like molasses), Mineral mixture 03.00 per cent respectively and T_2-nonconventional composed of Mango seed kernel 25.00, prosopis juliflora 24.00, Babul pods chuni 15.00, cassia tora seeds 06.00, Corn steep liquor 15.00, Urea 01.00, Jaggery solution 10.00 and mineral mixture 03.00 per cent respectively and basal diet was fed *ad libitum* individually for 180 days under feedlot system. The results of the study showed that lambs grew at the rate of 63.38 ± 3.25 and 48.80 ± 2.50 g/d to attaine boy weight of 21.35 ± 1.26 and 18.51 ± 0.85 kg body weight at 11 months of age under conventional and non- conventional treatment groups, respectively. Ismail and Tamir (2006) reported that supplementation of *sorghum* stover by up to 45% of khat leftover improves the weight gain of goats, while Hossain *et al.* (2003) studied the effects of three feeding regimes on growth performance and reproductive performance of sheep and goats. They affirmed that the weight gain increased in both sheep and goats as the energy levels increased in the diet of sheep and goats. Karim *et al.* (2007) conducted research on the Kheri breed with 6 month old finished lambs under extensive management and grazing with *ad libitum* concentrate supplementation or intensive feeding. The better growth rate was observed in supplement group followed by intensive and extensive arrangement groups.

Meanwhile, Safaria *et al.* (2009) studied the effects of concentrate supplementation on carcass and meat quality of feedlot finished small East African goats. In this study they used 23 animals of approximately 14.5 months age and 20.1 kg body weight were and fed *ad libitum* different or less than this *i.*e (100%, 66%, 33% and 0%).They concluded that on 100% treatment group goats had 31g daily body weight gain which was higher by 14g/day than the other treatment groups. In another study, Aregheore, (2004) reported that daily weight gain of goats significantly increased when fed a mixture of sweet potato with different ratios of batiki grass 0:100, 50:50, 75:25 and 100:0 to the goats of 8-9 month of age with 12.3±0.18 kg body weight. They concluded that the weight gain of goats improved by the type of forage and inclusion level of the supplement. The greater weight gain was observed on mixed diets.

Influence of feeding practices on nutrients digestibility of small ruminants

The growth performance of small ruminants is a dependent variable, influenced by independent variables like digestibility of nutrient and the environment, while nutrients digestibility depends on two factors, one is animal related like species such as sheep and goats, breed and the other related to feed, quality and composition of feed. Significant reports relevant to the present study are reviewed as below. Further, Abu Zanat, (2005) studied the *Atriplex hainzus* and *Atriplex nummularia* effect on intake and digestibility of sheep by replacing the alfalfa hay in the diet of Awassi sheep. They observed that the treatments had significant effect on digestibility. The inclusion level of Atriplex numalaria up to 50% of the diet had no significant effect on the digestibility, whereas the inclusion of Atriplex halinzus above 25% reduced the dry matter organic matter digestibility. He concluded that Atriplem namularia is better than A. halimunas. The inclusion level of A. nummulari is better to replace 50% alfalfa without any negative effect on over all dry matter digestibility. Wildeus *et al.* (2007) fed a forage diet of *Medicago sativa* to Barbados Blackbelly Katahhdin and St. Croix breeds. They investigated intake, weight gain, digestibility and nitrogen use. They found that digestibility dry matter crude protein NDF and ADF in Blackbelly 58.3, 67.7, 41.8, 38.5, Katahdin 63.0, 72.3, 49.4, 44.0 and in St. Croix breeds 59.3, 69.4, 43.6, 36.5 respectively. Results of demonstrated that the digestibility of DM, CP, NDF, ADF was higher for Katahdin compared to Blackbelly with St. Croix breeds. Ahmed and Ahmed (1983) studied the intake and digestibility of cattle and sheep on berseem and sorghum forage. Both species were fed *adlibitum* and supplemented cattle with molasses while sheep were supplemented with dura grain. The digestibility was the same in cattle on sorghum and berseem while in case of sheep the better digestibility was found on berseem than sorghum. The digestibility of sorghum was improved by supplementation with dura grain and molasses in cattle and sheep, whereas supplementation had no significant effect on the digestibility of berseem in both species. Sarwatt, (1990) conducted a trial on growing sheep to study the effect of supplementation on intake, weight gain and digestibility. They selected 12 animals were randomly divided in treatment groups *i.e* only hay A, hay plus 150 gram marajea B, hay plus 300 gram merajea,C and hay plus *adlibitum* merajea D. They observed that supplementation significantly ($P< 0.01$) increased dry matter digestibility in animals on treatment D and crude protein digestibility was also better by three times in the un-supplemented group on treatment D and organic matter digestibility was increased with the increase of supplement in diets, significantly ($P<0.01$) higher in group D than other treatment groups.

Chobtang *et al.* (2009) evaluated the growth performance of Thai indigenous male goats fed different levels of crude protein in total mixed rations. They found that increasing levels of crude protein content in total mix ration not only improved crude protein intake but also enhanced crude protein digestibility. Faftine and Zanetti, (2010) investigated the effect of feeding maize stover alone or with multinutrient block on the growth of 24 Mozambican Landim goats aging 8 months with 11 kg (±0.61) average body weight, during the dry season. At the end of growth

trial, a 5 day digestibility trial was conducted. They reported higher digestibility (%) of dry matter (61.1 versus 46.6), crude protein (69.5 vs -5.60), neutral detergent fibre (55.5 vs 45.1) and acid detergent fibre (53.3 vs 43.3). However the contradictory and unimpressive results from various reviewed reports might be in part due to the reasons other than inter-species differences in digestive physiology. It is evident that wide difference in experimental conditions were represented by these several reports, like age, weight, breed of the experimental animals, number of animals per treatment, feed sources and chemical composition.

Influence of feeding practices on feed efficiency of small ruminants

Efficient feed is important for commercial rearing of small ruminants. Mahgoub *et al.* (2000) conducted trial on forty male Omani lambs to study the properties of feeding diets containing different levels of ME on weight gain and carcass composition. Ten lambs were slaughtered for initial information of carcass composition, while other three groups were fed diets with varying concentration of ME being of high, medium and low density. They reported increase of ME concentration in the diet improved conversion efficiency in lambs. Later on few other workers like Sheridan *et al.* (2003) reported that individual feeding of two pellet diets with varying energy levels *ad libitum* for either 28 or 56 days to the Boer goat and South African mutton Merino lambs after weaning improved weight gain in mutton Merino sheep significantly being higher than Boer kids. The inter-treatment difference was not significant in the case of the Boer kids. While, in the case of Merino mutton lambs the inter treatment difference was significant between high and low energy diets. Patel *et al.* (2004) carried out a trial on twenty four farms born weaned lambs, 12 each of Marwari and Patanwadi breed. The lambs were fed two dietary treatments *viz*. T1-conventional and T2-non-conventional individually for 180 days under a feed lot system. They reported that feed conversion efficiency in terms of dry matter, digestible crude protein and total digestible nutrient per kg gain was significantly influenced by dietary treatment in Patanwadi breed.

Meanwhile, Dzakuma *et al.* (2004) selected two goat-populations of the Spanis and Tennesse stiff-legged breeds from weaning to six months and fed the same ration with different levels i.e 100%, 85% and 70% containing same CP180g/kg and ME 65%. The feed efficiency for Spanish and Tennesse Stiff-legged breed from weaning to six month of age was 0.122 vs 0.167 grams and from nine to thirteen month was 0.088 vs 0.104 were significantly different from each other. The results of study revealed that the Tennesse Stiff-legged breed is more efficient than Spanish goats breed. Urge *et al*. (2004) conducted research on four breeds of goats Spanish, Boer, Alpine and Angora and reported that feed efficiency was greater in Angora and Boer goats than Alpine and Spanish goats in the first week to the twelfth week while lower efficiency was observed in Spanish goats than in Angora goats during weeks 13-14. Haddad, (2005) studied the effect of different forage and concentration ratios on the performance of Baladi kids. The kids were given four treatments containing (1)60:40, (2)45:55, (3)30:70 and (4)15:85 forage to concentrate ratio and reported average daily gain for kids fed the15:85forage concentrate ratio was better than kids fed the 60:40 high forage diet. While on 45:55 and 30:70 diets kids had intermediate daily weight gain. They reported that increasing concentrate in diets decreasing forage parts results in average daily weight gain and improve the feed efficiency. Haddad and Obeidat, (2007) reported that lambs performed better than kids on high concentrate diets. The lambs ate more and grew faster than kids. Kids were more efficient feed converters than lambs while kids had significantly lower feed to gain ratio. Aregheore, (2007) fed different levels foliage of fluted pumpkin i.e. O, 25, 50, 75 and100% to Angola Nubian goats. They reported feed efficiency 0.11, 0.18, 0.29, 0.37 and 0.24 grams while feed conversion ratio 9.1, 5.7, 3.5, 2.7 and 4.1 respectively. Later on Jabbar and Anjum, (2008) fed Lohi lambs with different concentrate and fodder ratios (forage to concentrate) 75:25, 50:50 and 25:75 and reported that feed conversion ratio averaged 16.41, 11.30 and 11.53, respectively. They concluded that feed conversion ratio was significantly different among treatment groups. Wildeus *et al.* (2007) studied performance of three sheep breeds. The animals were fed chopped alfalfa hay and allowed a 14 day adaptation period. The initial body weight was unusual between breeds. They concluded that feed to gain ratio between breeds were 8.7, 9.1, 10.5 in St. Croix, Katahdin and Barbados Black belly respectively the difference were non-significant. The sheep breeds, St. Croix and Barbados Black Belly sheep have lower average daily gain and gain: feed ratio than wool sheep breeds, while the St. Croix group seemed to be better than Barbados Black belly lambs. They also observed that hair x wool crosses better than purebred hair sheep and expressed similar average daily weight gain and G:F ratio to wool breeds. Karim *et al.* (2007) studied Carcass characteristics of Kheri lambs kept under various feeding management systems. The lambs were divided in to three treatment groups *i.e*. (A extensive range grazing only), (B grazing with *ad libitum* concentrate supplement), (C, intensive feeding). They observed that feed conversion efficiency was higher in lambs maintained under grazing with supplementation than intensive and extensive range management.

Influence of feeding practices on economics

The feeding economics varies according to the cost of ingredients and is also influenced by the intake of animals and the efficiency of feed to be converted in per unit body mass and the ability of animal to convert dry matter intake to per unit weight gain. The feeding economics of sheep and goats in literatures is variable, regarding to feeding economics of small ruminants. Important results of researchers relevant to the present study are reported here. Patel *et al.* (2004) carried out a trial on weaned lambs from four farms, 12 each of Marwari and Patanwadi breed and were fed two dietary treatments *viz*. T1-conventional and

T2nonconventional individually for 180 days under feed lot system. They concluded that the cost of production in terms of per kg gain and per kg dressed weight was economical in nonconventional treatment group due to the use of cheaper non-conventional ingredients. While in a similar study Trived *et al.* (2005) fed two creep mixtures to the lambs and found that the performance of lamb was similar on conventional and non-conventional creep mixture in term of per kg gain and per kg dressed weight. They concluded that conventional and non- conventional creep mixtures are useful for improvement of growth rate in pre weaning lambs and recommended that the latter could be safely and economically used for lamb rearing. Legesse *et al*. (2005) compared the intensive, semi-intensive and extensive feeding systems in Somali goats. They divided the goats into three treatment groups *i.e*. first group was reared intensively, second group was fed semi-intensively and third were kept extensively. They found that goat reared on semi-intensive performed better than other treatment groups. They concluded that the semi-intensive system of feeding is more cost effective than intensive and extensive systems.

Since than a few other workers like Haddad and Obeidat, (2007) conducted an experiment on Awassi lambs and Baladi kids to evaluate the performance of sheep and goats on concentrate finishing diets. They reported that the cost of production in terms of per kg gain was lower in kids than lambs under confined feeding systems. Jabbar and Anjum, (2008) conducted a trial on fattening performance of Lohi lambs to study the effect of different forage to concentrate ratios. They fed the animals with different levels of forage to concentrate of 75:25, 50:50 and 25:75 A, B and C, respectively for a period of 66 days. They observed that cost of production/ kg gain was Rs. 74, 61 and 55 for groups A, B and C respectively. They concluded that the forage to concentrate ratio 25:75 is cost effective for mutton production. A few other workers like Belewu and Olajide, (2010) in an experiment selected West African dwarf goats to study the effect of different dietary treatments on intake, weight gain and digestibility of goats. They divide goats in to three treatment groups, A, B, C. The treatment A consisted only hay B, 50:50 soyabeen meal and muscuna seed meal and C diet was 100% muscuna, seed meal. The feed cost of treatment groups. A= 147.59, B= 81.04 and C= 30.12. They concluded that C diet was economical than other treatment groups. It is concluded that the cost of production per kilogram live weight gain in small ruminants can be enhanced by using cheaper ingredients of concentrate. The use of concentrate as a supplement source in grazing animals is a more cost effective production system than the animal grazed on forage or fed under intensive conditions without concentrate supplementation.

CONCLUSION AND SUGGESTIONS

The feeding behavior, diet intake, nutrients digestibility, feed efficiency and other performance parameters vary in goats and sheeps with the type of feeding practice. Overall the main influences in this regards are feed source, feeding pattern, feed quality, nutrients composition of feed and environmental factors. This review study suggests that there is a need of research projects carried out on local breeds of sheep and goat within their regional climatic conditions and locally available natural feeds. Further, the performance of those breeds needs to be evaluated with their native feed resources.

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