



Evaluation of Silage Based Ration in Lactating Goats under Stall-fed Condition

Ravindra Kumar*, Dori Lal Gupta, Kamendra Swaroop and Mohd. Arif

Division of Animal Nutrition, Management and Product Technology,
ICAR-Central Institute for Research on Goats, Makhdoom, Farah, Mathura-281 122, India

ABSTRACT

The present experiment was conducted to study the effect of feeding maize silage based ration on milk yield and composition in lactating Barbari goats under intensive system. Twelve Barbari goats (age 2-3 years with avg. body weight of 35.58 kg) at mid lactating stage were divided into two groups (CON and SIL) of six each. Goats were randomly divided on the basis of body weight and milk yield. Goats of CON group were fed with 600 g concentrate pellets and 500 g greens/head/day and *ad libitum* gram straw, while goats of SIL group were fed with 600 g concentrate pellets and *ad libitum* maize silage. Does were kept under stall fed system with uniform management conditions by housing them in well ventilated sheds. The duration of experimental feeding was 37 days. Body weight changes, milk production and milk composition were recorded during experimental feeding. There was no statistically ($P < 0.05$) significant change in the initial and final body weight of the goats of either group. Average daily dry matter intake (% body weight) was significantly ($P < 0.05$) higher in CON (5.47) as compared to SIL (3.88) group. There was also no significant ($P < 0.05$) difference in daily milk production between CON and SIL group of goats. Different milk constituents (%) like total solids, moisture, solid not fat (SNF), pH, ash and protein content of the milk were statistically ($P > 0.05$) similar between CON and SIL group of goats. Present study concluded that lactating goats can be fed with silage based ration without any adverse effect on milk yield and composition.

Key words: Maize silage, Feed intake, Lactating goats, Milk production, Milk composition

INTRODUCTION

Commercial goat production is coming up in urban and peri-urban area of India to meet the demand of milk and meat in urban market at better price. In recent times, the demand for goat milk has increased due to its nutraceutical properties (Kumar *et al.*, 2016). Hence, dairy goat farming in peri-urban areas could be an economically viable entrepreneurial proposition. In contrast to the traditional pastoral system of goat rearing, in peri-urban areas, goats are generally reared in intensive system and are fed in stalls with concentrates, crop residues and green fodder. All these feed resources are generally procured from nearby localities or from feed manufactures. Though highly labour and capital-intensive system (Sahoo *et al.*, 2015), this system of goat rearing is coming up in peri-urban areas driven by better market access to cater the growing demand for meat and milk. Feeding system based on complete pellet feed is quite helpful in these farms as no community grazing land is available in these

areas. Complete pellet feed is a technology that provides synchronized supply of nutrient in the rumen of ruminant animals with higher nutrient use efficiency for production functions. Feeding of pellet disallow the selective ingestion habits of the goat, providing the ease in using unconventional feeds, fortifying several limiting dietary components that facilitates balanced nutrient delivery for fermentation. This complete feed will provide all the nutrients required by the goats to meet their physiological and production demand. Whilst complete pellet feed technology can provide good portion of the ration, a goat farm will still need a sustained supply of quality green fodder round the year. Unfortunately, supply of green fodder is inadequate and erratic. Under this circumstance, feeding of goats with available concentrates and silage would be a practical approach. Goats are highly selective in their food choice (Goetsch *et al.*, 2010). Silage feeding in goats is not quite as widespread as in dairy cattle. In all continents, both for lactating and dry goats, the

*Corresponding author: E-mail: ravindra.kumar@icar.gov.in

roughage mainly comprise of grasses, fresh or as hay (> 80 per cent), the rest being crop residues. (FAO and IDF, 2014). Majority of work related with silage feeding is in large ruminants like cattle and buffalo (Hayashi *et al.*, 2009; Khan *et al.*, 2015). There are some reports on feeding of silage in lactating goats (Abedo *et al.*, 2013; Canizares *et al.*, 2011) with variable response on milk production and composition. Keeping these facts in view the present experiment was conducted to evaluate the lactation performance of Barbari goats on silage based feeding system.

MATERIALS AND METHODS

This experiment was conducted at Animal Experimental unit, Animal Nutrition and Product Technology Division, ICAR-Central Institute for Research on Goats, Makhdoom, Farah, Mathura, India. It is located at 27° 10'N latitude and 75° 28'E longitude at 169 m above sea level. The feeding trial was conducted from 27 Dec 2020 to 01 Feb 2021 (37 days).

Maize (*Zea mays*) was grown in the Agriculture farm of CIRG, Makhdoom. The variety of maize was QPM Shaktiman 5. The maize was harvested at mid flowering stage having 20-30 % of maize grain. The harvested maize was cut into small pieces with the chaff cutter. This chaffed maize was tightly packed in double layered plastic silage bags and kept for anaerobic fermentation for 60 days. After 60-75 days of anaerobic fermentation the bags were opened one by one and goats were fed with these silage.

Feeding cum lactation trial was conducted on twelve mid-lactating Barbari goats (age 2-3 years with average body weight (BW) of 35.58 kg). They were divided into two groups (CON and SIL) of six each. Goats were randomly divided on the basis of body weight and milk yield. Goats of CON group were fed with 600 g concentrate pellets and 500 g barley green/head/day and *ad libitum* gram straw while goats of SIL group were fed with 600 g concentrate pellets and *ad libitum* maize silage. Feeding was done to meet the nutrient requirement as per NRC (1981). Composition (on dry matter (DM) basis) of concentrate pellet was maize grain, 20%; barley grain, 20%; groundnut cake, 6%; soybean meal, 5%; mustard cake, 5%; guar korma, 5%;

wheat bran, 15%; de-oiled rice bran, 14%; molasses, 7%; mineral mixture, 2% and Salt, 1%. Does were kept under stall fed system with uniform management conditions by housing them in well ventilated sheds. The duration of experimental feeding was 37 days (27 Dec 2020 to 01 Feb 2021). Weighed quantities of concentrate pellet were offered to both the group of goats at 08:00AM daily. After complete consumption of pellet roughage portion of ration was offered to the goats. *Ad libitum* water was provided and was changed twice daily throughout the experimental period. Silage offered and residues were sampled weekly for subsequent analysis of DM to determine DM intake. Body weight was recorded fortnightly by weighing each animal with the help of digital balance. Milk yield of each of the goats was recorded at weekly interval during experimental feeding by individual milking. Goats were milked twice daily at 6 AM and 3 PM. Milk was weighed using electronic balance to estimate amount of milk produced. Representative milk samples collected after one month of experimental feeding were stored at -20°C for analysis of different milk constituents.

Nutrient composition of concentrate, gram straw and silage were analysed using the protocol described by AOAC (1995). Neutral detergent fiber (NDF), and acid detergent fiber (ADF) were determined as per the method of Van Soest *et al* (1991). Immediately after opening of silage bags, pH of silage was recorded with the help of digital pH meter. Dry matter of silage was estimated by toluene distillation method. Milk samples were analysed for different milk constituents like fat, solid not fat (SNF), protein and lactose using automatic milk scanner.

The data collected during the study were analyzed by using independent sample t-test as per Snedecor and Cochran (1989) using statistical software package (SPSS). Individual animals were considered as experimental units. Significance was declared at P<0.05.

RESULTS AND DISCUSSION

Data pertaining to chemical composition of concentrate pellet, gram straw and maize silage used for experimental feeding of lactating goats is presented

Table 1. Chemical composition of feed used in experimental feeding (on DM basis)

Attributes (%)	Gram straw	Maize silage	Concentrate pellet	Barley green
Organic matter	91.75	91.18	93.49	87.41
Crude protein	6.11	7.84	18.18	6.74
Total ash	8.24	8.82	6.51	12.58
Ether extract	0.42	1.40	3.17	2.41
Neutral detergent fibre	63.24	66.23	23.81	62.91
Acid detergent fibre	49.44	40.76	12.70	40.02

in table 1. The average pH of maize silage was 3.68 \pm 0.010 which indicate that quality of silage was good and fermentation was proper. The dry matter content of maize silage was 21.35% while crude protein (CP) content was 7.84% on DM basis.

Data on body weight changes and feed intake of goats are presented in Table 2. There was no statistically ($P < 0.05$) significant change in the initial and final body weight of goats of either of the group. Data indicate that nutrient intake was sufficient to maintain the body weight and milk production in both the group of goats. Roughage intake (g/day) was significantly ($P < 0.05$) higher in CON as compared to SIL group, indicating that gram straw was more palatable as compared to maize silage. Average daily DM intake (DMI) as proportionate to body weight was also significantly ($P < 0.05$) higher in CON (5.47 %BW) as compared to SIL (3.88 %BW) group.

However, there was no significant ($P < 0.05$) difference in daily milk production between CON and SIL group of goats. Maize silage is a well digestible and high energy value feed especially for dairy animals. Starch, in the kernels, optimizes the growth of rumen microbial population and influences the rate of

microbial protein synthesis, nitrogen utilization and production of volatile fatty acids (Jalèet *et al.*, 2009). Adogla-Bessa and Aganga (2000) found that supplying the right amount of corn silage, improved production and reproduction of livestock. Corn silage can be an economic source of nutrients for domestic animals (Oelker *et al.*, 2009). Different milk constituents *viz.* total solids, solid not fat (SNFs), pH, ash and protein content of the milk was statistically ($P > 0.05$) similar in CON and SIL group of goats (table 3).

Milk fat (%) was slightly more in goats fed with maize silage based ration. The mineral content of milk (sodium, potassium, calcium and phosphorus) was also statistically similar in CON and SIL group of goats. Abedo *et al.* (2013) studied the effect of feeding microbe inoculated corn silage on feed consumption, milk production and composition in dairy Zaraibi goats. They reported that average feed consumption of silage and total dry matter intake were increased for does fed with microbial inoculated silage. Feeding microbial inoculated corn silage increased milk production, milk contents of protein and lactose, and increased haemoglobin, serum glucose, total protein, albumin and globulin. Advantageous change in the milk composition is good

Table 2. Body weight (kg) and feed intake in different group of lactating goats

Attributes	CON	SIL
Initial body weight (kg)	28.55 \pm 2.46	27.20 \pm 2.28
Final body weight (kg)	28.72 \pm 2.49	26.37 \pm 2.09
Intake		
Roughage intake (g/day)*	1012.12 \pm 37.17	463.53 \pm 23.17
Average daily dry matter intake (g/day)*	1552.62 \pm 26.93	1000.59 \pm 39.87
Average daily dry matter intake (% BW)*	5.47 \pm 0.11	3.88 \pm 0.19

*Differ significantly at 5% significance level

Table 3. Milk production and composition in different group of lactating goats

Attributes	CON	SIL
Milk production (g/day) (days of collection)		
7	882.33±54.53	858.25±55.93
14	842.33±26.69	904.50±48.93
21	901±10.96	837.50±116.06
28	888.00±2.08	938.0±51.58
35	865.66±32.98	712.75±88.06
Milk composition (28th day of collection)		
Total solids	12.99±0.31	14.71±1.24
pH	6.33±0.01	6.35±0.01
Salt (%)	0.75±0.01	0.82±0.04
Fat (%)	3.82±0.31	4.73±0.68
Solid-not-fats (%)	9.17±0.16	9.97±0.56
Density	31.46±0.72	33.73±1.57
Protein (%)	3.35±0.06	3.64±0.20
Lactose (%)	5.03±0.09	5.47±0.30

as changes in milk composition will be reflected on the nutritional, technological and economic values of goat's milk as well as of other dairy products (Huhtanen *et al.*, 2003). However, in present study no change in the milk composition is reported on introduction of silage in the ration of lactating goats. The difference in response could be due to the fact that we did not use any microbe inoculated silage. The beneficial effect that was observed in previous studies could be due to positive influence of the microbe-based silage additive.

CONCLUSION

Present study concluded that lactating goats can be reared on silage based feeding without any adverse effect on milk production and composition. This study broadens the feed resource for goats mainly under the stall feed condition and farmers can use silage in the feeding of lactating goats.

ACKNOWLEDGEMENTS

The research facilities and funds provided by Director, ICAR-Central Institute for Research on Goats, Makhdoom for this work are greatly acknowledged.

REFERENCES

Abedo, A.A., Hafez, Y.H., Khalifa, E.I., Bahera, K.M. and El-Zolaky, O. A. 2013. Milk yield and composition of dairy Zaraibi goats fed microbial inoculated corn

silage. *Egyptian J. Sheep Goat Sci.* 8: 141-151.

Adogla-Bessa, T. and Aganga, A.A. 2000. Milk production of Tswana goats fed diets containing different levels of energy. *South Afr. J. Anim. Sci.* 30: 7781.

AOAC. 2006. *Official Methods of Analysis*. 18th edn. Association of Official Analytical Chemists, Washington, DC, USA.

Canizares, L.G., Heraldo, C.G., Ciniro, C., Luciana, R., Jakilane, J.L.M., Helen, F.B.G., Raquel, O.M. and Renata, H.B. 2011. Use of high moisture corn silage replacing dry corn on intake, apparent digestibility, production and composition of milk of dairy goats. *R. Bras. Zootec.* 40: 860-865.

FAO, IDF and IFCN. 2014. World mapping of animal feeding systems in the dairy sector. Rome. <http://www.fao.org/3/i3913e/i3913e.pdf>.

Goetsch, A.L., Gipson, T.A., Askar A.R. and Puchala R. 2010. Feeding behavior of goats. *J. Anim. Sci.* 88:361-373.

Hayashi, Y., Thapa, B.B., Sharma, M.P., Sapkota, M. and Kumagai H. 2009. Effects of maize (*Zea mays L.*) silage feeding on dry matter intake and milk production of dairy buffalo and cattle in Tarai, Nepal. *J. Anim. Sci.* 80: 418-27.

Huhtanen, P., Nousiainen, J.I., Khalili, H., Jaakkola, S. and Heikkilä, T. 2003. Relationship between silage fermentation characteristics and milk production parameters: analyses of literature data. *Livest. Prod. Sci.* 81: 57-73.

Jalè, D., Varadyova, Z., Laukova, A., Homolka, P. and Janèik,

- F. 2009. Effect of inoculated corn silage on rumen fermentation and lipid metabolism in an artificial rumen (RUSITEC). *Anim. Feed Sci. Technol.* 152: 256-266.
- Khan, N.A., Yu, P., Ali, M., Cone, J.W. and Hendriks, W.H. 2015. Nutritive value of maize silage in relation to dairy cow performance and milk quality. *J. Sci. Food Agric.* 95: 238-52.
- Kumar, H., Yadav, D., Kumar, N., Seth R. and Goyal, A.K. 2016. Nutritional and nutraceutical properties of goat milk - A review. *Indian J. Dairy Sci.* 69: 513-518.
- NRC. 1981. *Nutrient Requirements of Goats*. National Academy of Sciences, National Research Council, Washington, DC.
- Oelker, E.R., Reveneau, C. and Firkins, J.L. 2009. Interaction of molasses and monensin in alfalfa hay- or corn silage-based diets on rumen fermentation, total tract digestibility and milk production by Holstein cows. *J. Dairy Sci.*:92: 270-285.
- Sahoo, A. Bhatt, R.S. and Tripathi, M.K. 2015. Stall feeding in small ruminants: emerging trends and future perspectives. *Indian J. Anim. Nutr.* 2: 353-372.
- Snedecor, G.W. and Cochran, W.G. 1989. *Statistical Methods*. 7th ed. The Iowa State University, Iowa, USA.
- SPSS. 1995. *Statistical Packages for Social Sciences*. Version 7.5. SPSS Inc., IL, USA.
- Van Soest, P.J., Robertson, J.B. and Lewis, B.A. 1991. Methods of dietary fibre, neutral detergent fibre and non-starch polysaccharides in relation to animal nutrition. *J. Dairy Sci.* 74: 3583-97.

Received on 09-06-2021 and accepted on 22-06-2021