

Short Communication

A self-limiting complete feed changes forage intake and animal performance of growing meat goats

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Abstract

Rangeland or hay-based finishing systems often do not allow kids to reach slaughter weights of 30 - 50 kg by 12 months. This study determined the effects of a complete feed (CF) and a self-limiting complete feed (LCF) alone or in combination with *ad libitum* access to sorghum-sudan hay (SS) on average daily gain (ADG) and cost of gain of Boer cross doelings. Thirty kids (21.1 kg) were randomly assigned to one of five treatments (SS, CF, LCF, SS + CF, and SS + LCF). The ADG over 63 days was greater for all treatments with CF and LCF when compared with SS (21.8, 152, 123, 181, and 172 g/d for SS, CF, LCF, SS + CF and SS + LCF, respectively). In this experiment, traditional and self-limiting supplements for forage-fed goats were useful in increasing ADG and controlling supplement intake when compared with supplement feeding alone. There were no statistical differences between the costs of gain for the five treatments. Finishing systems that promote gains of 4.6 to 7.3 times those of hay-only systems should be attractive to producers.

Keywords: Forages, supplementation, small ruminant, intake limiter

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Non-supplemented rangeland, pasture and hay-based finishing systems do not support rapid weight gains, or in some cases even allow kids to reach an appropriate slaughter weight at an age where carcass quality is considered to be optimum (Huston *et al.*, 1993; Ott *et al.*, 2004). A realistic goal for both optimum carcass quality and carcass yield could be defined as goats slaughtered at less than one year of age weighing 30 - 50 kg. Finishing systems that promote significant gains over those of the predominant rangeland or hay-only systems should be economically attractive to producers and allow goats to reach slaughter weight more quickly.

Ad libitum supplement feeding in pasture-based systems has shown higher average daily gains (ADG) in growing goats, but can result in decreased forage consumption due to substitution of forage intake with intake of supplement (SCA, 1990; Huston, 1994). Given the relative costs of supplements and forages, it is likely that substitution of a significant portion of forage with a supplement would result in an increased cost of gain. This substitutive effect might be reduced by feeding a supplement with an intake limiter to forage-fed goats. The aim of this experiment was to determine: 1) the average daily gain of goats consuming sorghum-sudan hay, a complete goat supplement with and without access to sorghum-sudan hay, or a complete goat supplement with an intake limiter with and without access to sorghum-sudan hay; 2) the effectiveness of the intake modifier at reducing supplement intake and potentially reducing the tendency for supplement to replace forage intake, and 3) the effect of the above treatments on the economics of gain in young, growing meat goats.

This study was performed at the Texas Agricultural Experiment Station in Stephenville, TX. All protocols were approved by the Texas A&M University Animal Care and Use committee. Boer × Spanish doe kids of similar age and origin arrived at the Texas Agriculture Experiment Station 14 days prior to the start of the experiment for a period of acclimatization. During this time, sorghum-sudan hay was available to all goats on an *ad libitum* basis. At the end of the acclimation period, 50 kids (21.1 kg; *ca.* 150 days of age) were randomly assigned to one of five treatments (two pens per treatment; five goats per pen). The

treatments included: *ad libitum* access to sorghum-sudan hay (SS), *ad libitum* access to a complete supplement (CF; 16% kid starter grower, Purina Mills, St. Louis, MO 63166), *ad libitum* access to complete supplement with an intake limiter (LCF; nutritionally similar to CF with the exception of proprietary intake limiting ingredients), *ad libitum* access to SS + CF, or *ad libitum* access to SS + LCF. *Ad libitum* access to clean drinking water was provided at all times during the experiment. The proprietary intake limiter was supplied as part of the LCF diet (Purina Mills, St. Louis, Missouri, USA).

Does were weighed at the beginning and end of the 63 day experiment for calculation of weight gain. Average daily gain was calculated by dividing total weight gain by 63 (number of days in the experiment). Intake of CF and LCF was estimated by subtracting the feed remaining in the trough at the end of each 7-day period from the sum of the previous 7-day feedings. A crude estimate of hay consumption was measured twice during the experiment (final two days of weeks 4 and 8) by placing large square tarpaulins beneath the hay feeders for a period of 24 hours to measure hay intake, waste and refusal in and around feeders.

Data for gain, SS intake and cost of gain were analyzed as a randomized design with repeated measures using PROC MIXED of SAS (2005). The model included effects of treatment, week (repeated measure) and the treatment by week interaction with pen as the experimental unit. When model main effects were significant ($P \leq 0.05$), treatment means were computed using the LSMEANS statement of SAS. Mean separation was accomplished using the PDIFF option of the LSMEANS statement. Intake of CF and LCF were compared using a paired T-test in SAS. For cost of gain calculations, 0.253, 0.286, and 0.132 US dollars per kg of feed were assumed for CF, LCF, and SS, respectively. Cost of gain was calculated as the sum of the cost of all feed ingredients consumed by each pen of goats divided by the ADG of that pen of goats.

Diets (LCF and CF) were similar in crude protein, total digestible nutrients (TDN), calcium, and phosphorus; however, ether extract was 1.24% higher in LCF than CF due to the addition of the intake limiter (Table 1).

Table 1 Nutrient content (as-fed basis) of the sorghum-sudan hay (SS), complete feed supplement (CF) and complete feed supplement with intake limiter (LCF)

	SS	CF	LCF
Crude protein, g/kg	77	160	160
TDN, g/kg	480	675	680
Ether extract, g/kg	-	22	35
Calcium, g/kg	-	11.5	11.6
Phosphorus, g/kg	-	5.8	6.2

TDN - total digestible nutrients

Growth, feed intake and cost of gain data are presented in Table 2. For goat ADG, there was a significant effect of treatment ($P < 0.0001$). Average daily gains (normalized to a per goat basis) were 21.8, 151.6, 181.0, 122.6, and 172.1 g/d for SS, CF, SS+CF, LCF, and SS+LCF, respectively. Gains for forage-fed goats are similar to those reported by Packard *et al.* (2007) and Moore *et al.* (2002) for forage-fed goats. However, gains observed in this study for goats fed a complete ration (with or without forage availability) are approximately 60 g/d greater than those reported by Packard *et al.* (2007). All treatments produced superior gains when compared with SS ($P < 0.05$), but did not differ from each other. This agrees with the data of Kiesling & Swartz (1997) and Johnson & McGown (1998) who reported significant increases in ADG of supplemented goats as compared to goats fed only forage. Average daily gain was increased ($P < 0.05$) for SS+LCF when compared with LCF alone, but ADG for CF and SS+CF did not differ ($P = 0.24$). The observed decrease in ADG for goats consuming LCF when forage was not available indicates that the intake limiter in LCF was potent enough to reduce intake sufficiently to reduce ADG. This

hypothesis is strengthened by the observation that supplement intake was less ($P < 0.01$) for LCF compared to CF goats while forage intake was greater in LCF goats as compared to CF goats.

Cumulative gains for the entire 63-day period were 1.38, 9.55, 11.41, 7.72, and 10.84 kg per goat for SS, CF, SS+CF, LCF and SS+LCF, respectively. There was a significant effect of treatment ($P = 0.019$). All treatments produced superior gains when compared with SS ($P < 0.05$), but did not differ from each other.

Table 2 Means for cumulative gain, average daily gain, feed intake, and cost of gain for goats consuming sorghum-sudan hay (SS), a complete feed supplement (CF), a complete feed supplement with an intake limiter (LCF), SS + CF, or SS + LCF

	SS	CF	SS + CF	LCF	SS + LCF	s.e. ¹	P ²
Cumulative gain, kg	1.38 ^a	9.55 ^b	11.41 ^b	7.72 ^b	10.84 ^b	1.40	0.019
Average daily gain, g	21.8 ^a	152 ^b	181 ^b	123 ^b	172 ^b	22.2	< 0.001
SS Intake, kg DM per day	0.56 ^a	-	0.24 ^b	-	0.39 ^c	0.04	< 0.001
Cost of gain, US\$ per kg	3.41	2.39	2.49	2.89	2.62	0.44	0.55

¹ Standard error of the mean

² Effect of treatment

^{a,b,c} Means within row with different superscript differ ($P < 0.05$)

*Different from CF ($P = 0.01$)

†Different from SS + CF ($P < 0.01$)

Intake of SS was determined during two 24-hour periods of the experiment. While this is not the optimal method for determination of SS intake, this method provides a crude estimate of SS consumption for comparative purposes and has been used in other studies (Packard *et al.*, 2007). Goats consuming SS alone consumed 0.56 kg per day of SS. When goats were offered SS + CF, SS intake was reduced ($P < 0.05$) to only 0.24 kg per day. Goats offered SS + LCF had intermediate ($P < 0.05$) SS intakes (0.39 kg per day) compared to SS and SS + LCF. Intake of LCF (1.23 kg per day) was less ($P < 0.05$) than CF (1.43 kg per day). Further, intake of LCF was less ($P < 0.05$) than CF intake regardless of the availability of SS. Availability of CF to SS supplemented goats resulted in a 57% decrease in SS consumption when compared with SS alone.

When free choice supplements are offered to forage-fed goats, a substitution of supplement for forage is often observed. Huston (1994) reported a decrease of 22% in forage intake when goats were supplemented at 30% of their digestible energy requirement, as compared with unsupplemented goats. Osuji & Odenyo (1997) reported a decrease of 10% in forage intake when goats were supplemented at 1.5% of bodyweight with lablab legume hay. A self-limiting supplement, such as LCF, could provide a means to reduce the substitution effect observed with free-choice supplements

Calculated cost of gain for CF was lower (US \$2.39/kg) than the other treatments. Relative to the cost of gain for CF, costs of gain were 1.04, 1.10, 1.21, and 1.42 times that of CF for SS + CF, SS + LCF, LCF and SS, respectively. There were no statistical differences between the costs of gain for the five treatments.

In this experiment, a self-limiting feed supplement successfully decreased supplement intake and concomitantly increased forage intake resulting in a similar ADG of a traditional supplement. With the forage-based feeding system used in this experiment, goats gained only 21.8 g/day. This rate of gain is not sufficient to allow goats to reach 30-50 kg by one year of age and thus would result in either small carcasses for goats slaughtered at one year of age, or goats older than one year of age when reaching slaughter weight. Self-limiting supplements may be useful for producers seeking to control supplement intake with limited labour while maintaining performance comparable to traditional supplement/forage feeding systems.

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