

## The Effect of Feed Supplementing and Processing on the Live-Weight Gain of Tibetan Sheep During the Cold Season on the Qinghai-Tibetan Plateau

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**Abstract:** Overgrazing and grassland degradation are ongoing concerns for the Qinghai-Tibetan Plateau under the present use of the traditional sheep production system. In order to protect the plateau and still enable the local herders to raise their sheep the effect of feeds processing on Tibetan sheep productivity during the cold season was undertaken to determine the effect of supplementing with three different feed processing of concentrate plus oat grass on 18 castrated Tibetan sheep (aged 10 months) previously grazed on local range/pasture. The effects on live weight gain, apparent digestibility and feeds conversion were measured. The three different diets were diet 1: non-processed concentrate + oat grass, diet 2: steam flaked concentrate + oat grass and diet 3: steam flaked concentrate + silage oat grass. The results showed that diet 3 had the highest Average Daily Gain (ADG) (160.33 g). This was 97 g greater than that of diet 1 ( $p < 0.01$ ) and 54.67 g greater than diet 2 ( $p < 0.05$ ). Diet 2 was 41.67 g greater ( $p < 0.05$ ) than that of diet 1. Similar results were obtained among the three diets in regards to apparent digestibility and feedstuff conversion. Compared to the traditional Qinghai-Tibetan Plateau's sheep production system, all three of the tested diets had higher ADG and reduced feedstuff conversion. Applying concentrate/fodder supplementation and processing could thus shorten the sheep's lifecycle reducing the number of Tibetan sheep on the plateau and therefore, decrease the grazing pressure on the open grasslands.

**Key words:** Feeds processing, live-weight gain, apparent digestibility, feeds conversion, Tibetan sheep, Qinghai-Tibetan Plateau

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### INTRODUCTION

Tibetan sheep, one of the dominant livestock species on the Qinghai-Tibetan Plateau have been grazed on the plateau for 1000 of years. Due to herbage shortage in the long, harsh cold season (October to May) the sheep suffer from inadequate feed under the traditional farming system resulting in large seasonal body weight variations (Long *et al.*, 2005). The low efficiency of sheep meat production is compensated for by increasing the number of sheep to reach appropriate herd size for the economic needs. This in turn results in more overgrazing culminating in the continued vegetation and land degradation of the Qinghai-Tibetan Plateau (Wang *et al.*, 2007).

This situation warrants a need to improve sheep productivity through developing local, supplement resources and feed processing especially during the cold

season. Numerous reports of improved performance in feedlot cattle fed steam-flaked vs. dry-rolled corn have been published (Zinn, 1987; Barajas and Zinn, 1998; Leibovich *et al.*, 2009). Steers fed steam-flaked corn consumed 6% less feed, increased their rate of weight gain by 22% and were 30% more efficient than those fed dry-rolled corn (DiLorenzo *et al.*, 2011).

Although, the positive effects of concentrate and forage processing on the productive performance of the cattle are well documented, the effects of silage and steam-flaked concentration on the performance of Tibetan sheep in the cold season have not yet been reported. Therefore, the present study was envisaged to evaluate the live-weight gain, apparent digestibility and economic benefits of sheep fed different processing feeds during the cold season thus to recommend the best supplementary strategy for sheep-producers on the Qinghai Tibetan Plateau.

## MATERIALS AND METHODS

**Animals, diets and experimental design:** Eighteen castrated Tibetan sheep, aged 10 months were bought from nomadic herders of Guinan County, Qinghai Province in November 2010. They had been raised to this point by the traditional sheep grazing method. The eighteen sheep were randomly divided into three groups with 6 sheep in each group. The experiment was set in Guinan County from November 21, 2010 to February 10, 2011. The 81 days study was divided into two periods a 21 days preliminary period for the sheep to adjust to the diets and their surroundings and a 60 days feeding trial. The 3 groups were group I (sheep fed on non-processed concentrate with oat hay), group II (sheep fed on a steam flaked concentrate with oat hay) and group III (sheep fed on steam flaked concentrate with oat grass silage), respectively. Each group of sheep was kept in separate covered enclosure equipped with watering and feeding facilities. The diets were designed according to locally available feed in Guinan County. The concentrate mix contained 50% corn, 30% barley, 17% rape seed cake, 2% trace minerals-vitamins and 1% salt. The Crude Protein (CP), Crude Fat (CF), Neutral Detergent Fiber (NDF) and Acid Detergent Fiber (ADF) of feed in this study are presented in Table 1.

**Animal management:** During the preliminary period, the concentrate supplement levels of three groups increased from 100 g day<sup>-1</sup> per sheep to determined levels of 500 g day<sup>-1</sup> per sheep. All animals were fed twice daily at 8:00 and 18:00 (first the concentrate and then the roughage). Water was available at all times.

**Sampling:** Sheep were weighed before the morning feeding at the beginning of the feed trial and then before the morning feeding at the end of the trial. The leftover roughage of the previous feeding in the morning and evening was removed from each bunk, weighed and recorded to determine the next scale of feeding. This was done on an everyday feeding basis throughout the trial period. Feces of all group were collected on the last 2 days of the trial and the apparent nutrient digestibility of the sheep under the different diets was estimated by the following equation recommended by Fengxia and Liu (2004).

$$\text{Nutrient digestibility (\%)} = 100 - 100 \times \left( \frac{A_1}{A_2} \times \frac{F_2}{F_1} \right)$$

Where:

A<sub>1</sub> = Ash Insoluble Acid (AIA) in feeds (%)

A<sub>2</sub> = Ash Insoluble Acid (AIA) in feces (%)

F<sub>1</sub> = Nutrient content in feeds (%)

F<sub>2</sub> = Nutrient content in feces (%)

**Data analysis:** All data was analyzed using one-way ANOVA of SPSS13.0 package.

## RESULTS AND DISCUSSION

**Dietary digestibility:** The nutrient digestibility of three groups is presented in Table 2. The data indicated that Dry Matter (DM) digestibility of group III was greater than that of group I (p<0.01) and group II (p<0.05) and group II was significantly different than group I (p<0.05). There was significant difference between group III and I (p<0.05) but no significant difference between groups II and I (p>0.05) and between groups II and I (p>0.05) on CF digestibility. The CP digestibility of group III was greater than group I (p<0.001) and group II was significantly different than group I (p<0.05) but there was no significant difference between groups III and II (p>0.05). There was significant difference between group III and I (p<0.05) on NDF and ADF digestibility but no difference between groups II and I (p<0.05) and between groups II and I (p<0.05). GE digestibility of group III was greater than that of groups II and I (p<0.001) and group II was greater than group I (p<0.01).

**Feed composition and sheep growth performance:** The feed composition and daily live-weight gain for the three groups is presented in Table 3.

The results indicated that ADG of group III was 97.00 and 54.67g greater than that of group I (p<0.01) and group II (p<0.05), respectively and group II was 41.67 g greater (p<0.05) than that of group I.

Feed supplementation has been widely used to balance nutrition of ruminants fed low quality forage based diets in tropical and sub-tropical areas (Leng, 1984). Grain processing is the most widely used technology to improve animal performance in the feedlot industry (Vasconcelos and Galyean, 2007). The method of processing corn grain has a greater effect on the efficiency of bodyweight gain for finishing cattle than does using different hybrids of corn (Ladely *et al.*, 1995). Steam flaking of corn is now a typical method of processing corn grain in the world. It increases starch digestibility in the rumen and post-ruminally (Joy *et al.*,

Table 1: Feeds composition and nutrients of feed

Feeds	CP (%)	CF (%)	NDF (%)	ADF (%)
Concentrate	15.26±1.24	1.12±0.31	36.54±2.46	32.09±3.21
Steam flaked concentrate	16.41±1.62	1.06±0.42	37.57±1.73	32.19±2.87
Oat hay	7.28±0.47	0.89±0.84	72.88±1.26	45.48±3.22
Silage oat grass	7.52±0.83	1.19±0.26	72.19±2.39	45.88±3.45

Table 2: The nutrients digestibility of three groups with difference diets

Groups	DM (%)	CF (%)	CP (%)	NDF (%)	ADF (%)	GE (kcal g <sup>-1</sup> )
I	75.32±3.40 <sup>c</sup>	62.23±9.63 <sup>b</sup>	57.89±7.34 <sup>c</sup>	59.48±4.08 <sup>b</sup>	49.93±5.95 <sup>b</sup>	79.45±1.94 <sup>c</sup>
II	78.24±0.50 <sup>b</sup>	67.14±6.86 <sup>b</sup>	60.29±3.03 <sup>b</sup>	62.03±1.24	52.52±1.24	82.37±0.82 <sup>b</sup>
III	81.21±1.22 <sup>a</sup>	72.62±8.76 <sup>a</sup>	70.79±6.19 <sup>a</sup>	63.12±3.14 <sup>a</sup>	56.86±3.88 <sup>a</sup>	88.29±1.54 <sup>a</sup>

Table 3: Feeds composition and daily live-weight gain of sheep

Groups	Sheep number	Feed composition	Initial weight (kg/sheep)	Final weight (kg/sheep)	ADG (g)
I	6	Concentrate + oat grass	30.74±2.26	34.54±0.75	63.33±32.34 <sup>c</sup>
II	6	Steam flaked concentrate + oat grass	30.88±1.01	37.18±1.25	105.00±10.40 <sup>b</sup>
III	6	Steam flaked concentrate + silage oat grass	30.50±1.89	40.12±2.18	160.33±39.13 <sup>a</sup>

Different letters in the same column have statistical difference of at least  $p < 0.05$

Table 4: Feeds conversion comparison of two sheep production systems

Production systems	Consumption (kg)				Live-weigh (kg)	Carcass weight (kg)	Ratio WC/CW	Days to finish
	Herbage	Concentrate 60 days	Feedstuff 60 days	Whole consumption				
Concentrate and fodder supplementation								
I	553.5	30	30.13±3.24	613.63	34.54±0.75	14.03	43.74	365
II	553.5	30	38.23±4.26	621.73	37.18±1.25	15.11	41.15	365
III	553.5	30	59.42±1.21	642.92	40.12±2.18	16.30	39.44	365
Traditional production system	2700.0	-	-	2700.00	-	15.41	175.2	730

1997; Crocker *et al.*, 1998). *In vitro* rumen digestion of starch is higher for small particles compared to large particles (McAllister *et al.*, 1993).

Daily weight gain which affects the length of time from the sheep's birth to slaughter, determines the number and length of the lifecycle of sheep given the same production level. During the cold season, the weight of Tibetan sheep fed by traditional Qinghai-Tibetan Plateau's sheep production is decreasing instead of increasing. Ding *et al.* (2011) reported from a 90 days grazing experiment on sheep fed by the traditional sheep production/grazing a live weight loss of 6.49 kg sheep<sup>-1</sup> and an economical loss of 90.22 kg sheep<sup>-1</sup>. From this study, the sheep fed steam flaked concentrate with silage oat grass (group III) had the highest ADG among the three groups (gain 9.62 kg sheep<sup>-1</sup> during 60 days) and the live-weight gain of all three groups were higher than -6.49 kg sheep<sup>-1</sup> reported by Ding *et al.* (2011).

It has been reported that during the cold season, the apparent digestibility of CP, NDF and ADF of the traditional sheep production/grazing for Tibetan sheep were 56.7, 38.1 and 20.6%, respectively (Li *et al.*, 2009) and the apparent digestibility of DM was 49.91% (Fengxia and Liu, 2004). From the present study, the sheep fed steam flaked concentrate with silage oat grass (group III) had the apparent digestibility of CP, NDF, ADF and DM of 70.79, 63.12, 56.86 and 81.28%. Compared to the traditional Tibetan sheep production system, the Tibetan sheep had a higher apparent digestibility of nutrients applying concentrate/fodder supplementation and processing during the cold season.

Zhao (2000) reported that the herbage consumption for the 10 months Tibetan sheep was 553.5 kg and the feedstuff conversion (the ratio of

Whole-Consumption/Carcass-Weight (WC/CW) of 2 years old Tibetan sheep under the traditional production/grazing system was 175.2. For group III, II and I or the study the feedstuff conversions were 39.44, 41.15 and 43.74, respectively (Table 4). This fourfold difference represents that applying concentrate/fodder supplementation and processing had a high efficiency than that of traditional system on sheep production. The data also indicates that 1 year old sheep receiving supplemental concentrate according to the study can achieve the same carcass weight as that of a 2 years old sheep grazed under traditional production system.

## CONCLUSION

In this study, the sheep production was divided into three stages traditional grazing (birth to 10 months), transition to concentrate feed (21 days) and feedlot (60 days). It is a better way to raise Tibetan sheep using supplemental concentrate and oat grass hay or silage. During the cold season, sheep that were raised in enclosed pens and fed a steam flaked concentrate with silage oat grass would improve productivity of Tibetan sheep, reduce the sheep number and lifecycle of Tibetan sheep thus decreasing the grassland's over-grazing and degradation.

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